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THE MAGAZINE OF FLUID POWER

PUBLISHED BY THE INDUSTRIAL PUBLISHING CORPORATION

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...just PLUG IN THE POWER

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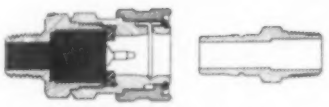

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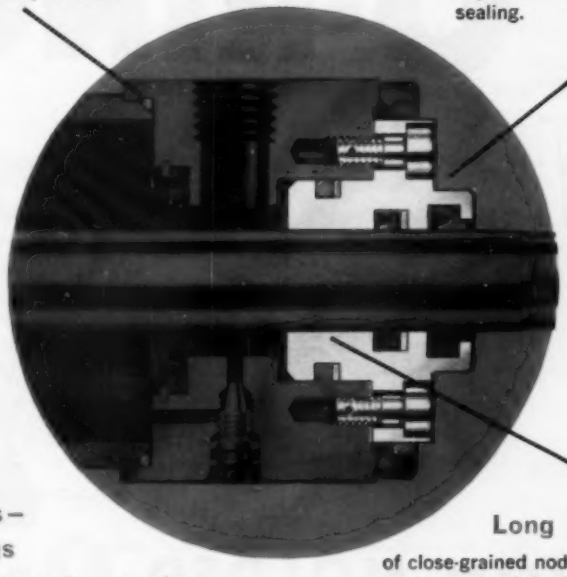

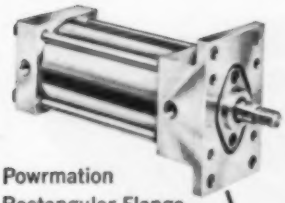

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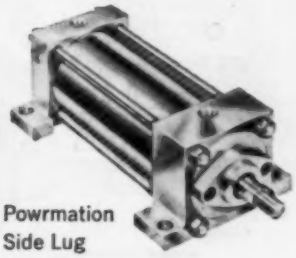
Rod End



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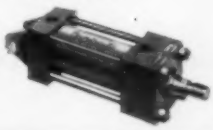

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or ask Your Hanna Representative—see the Yellow Pages or Sweet's Design Catalog for his name

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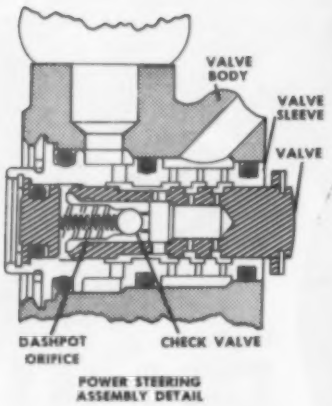

POWER STEERING ASSEMBLY DETAIL

- EXCLUSIVE INJECTION MOLDED
- HIGH DENSITY
- WEAR RESISTANT
- CUSTOM COMPOUNDS

INJECTION MOLDED O-RINGS give better service in any application

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VOLUME 13/NUMBER 2

FEBRUARY 1960

THE MAGAZINE OF FLUID POWER

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JACK LOWERY
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- For pressures to 3000 p.s.i.
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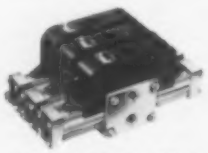

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Here it is—the new pace-setter in A.C. solenoid valves! Exclusive Waterman design has eliminated inrush current, making possible fast cycling (in excess of 250 per minute) without overheating. Standard coils suitable for 25 to 60-cycle current. Weight of ⅜" size is less than 6 lbs., including two solenoids. Closed-center, tandem, and two-position types available. Rated 3000 p.s.i. pressure may be applied to all ports. Working parts totally enclosed. No moving seals – packless. Screw-type electrical terminals in steel housing. Same valves can be furnished for D.C. operation.

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THE MAGAZINE OF FLUID POWER

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USEFUL LITERATURE

ANCHOR ANNOUNCES NEW AUTOMOTIVE AND FREON HOSE ASSEMBLY CATALOG

Just received, the new Anchor Catalog No. 602 includes complete description and specifications of Anchor Coupling Company's expanded automotive, industrial and Freon hose assemblies.

A number of styles are available in each category. In the low pressure automotive and industrial group, assemblies are available with maximum working pressures ranging from 175 psi to 500 psi for the smallest size, 3/16" I.D., and from 125 to 175 psi for the largest size. A wide range of coupling styles are available, both male and female, with SAE or NPTF thread for making up hose assemblies of the desired specifications.

In addition, examples of different styles of Power Steering Hose assemblies are illustrated to show some of the possible coupling arrangements. Such assemblies are always made up to the exact specifications required.

Two types of hose are shown from which assemblies used to transport Freon 12 are made up,—a 1-Rayon Braid Hose with a maximum working pressure of 350 psi and a 1-wire braid hose with a rubber impregnated cotton braid cover having a maximum working pressure of 500 psi. Contrary to most other hose types, the maximum working pressures for this hose are uniform for all sizes available from ¼" I.D. to ¾" I.D. rayon braid hose, and ¼" I.D. to 1" I.D. for the wire braid hose.

Bent tube assemblies are shown in several styles. These, too, are always made up to customers' specifications.

Write for copies of the Anchor Catalog No. 602.

Send requests to Anchor Coupling Co. Inc., 390 No. Fourth Street, Libertyville, Illinois.

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ANCHOR®...THE PLEDGE OF PERFORMANCE

IN HYDRAULIC TRANSMISSION LINES

Failure in a fluid power transmission line is usually costly, with expensive equipment down, production delays and idle manpower until repairs can be made.

To hold such breakdowns to a minimum, Anchor has not only established rigid quality standards to which all Anchor Hydraulic Hose Assemblies must conform, but makes frequent tests and inspections of materials and workmanship to ensure conformity to these high standards.

Because of this, the Anchor emblem on any piece of hydraulic equipment is a real "pledge of performance" and service.

Andy Anchor says:

"My condensed Bulletin No. 59S briefly describes the complete Anchor line. Send for it now!"

ANCHOR HOSE ASSEMBLIES with ANCHOR Pressed-On Couplings are available for high, medium and low pressure service with maximum working pressures ranging from 12,500 PSI for 3/16" I.D. 6 Ply Super Spiral Hose to 100 PSI for 2" I.D. Spiral Wire Suction Hose.

ANCHOR REUSABLE COUPLINGS — Regular or Clamp Type, are available for emergency repair and year-to-year superior performance for high, medium and low pressure service ranging from 5000 PSI for ¼" I.D. 2-Wire Braid Hose to 100 PSI for 2" I.D. Spiral Wire Suction Hose.

ANCHOR 4-BOLT SPLIT-FLANGE "O" RING HEAD COUPLINGS are available in a wide range of sizes for high, medium and lower pressure applications.

ANCHOR ADAPTER UNIONS, PIPE FITTINGS, SAE BOSS TYPE FITTINGS A complete line of Pipe and Tube Fittings, Adapter Unions and SAE Boss Type Fittings are offered in a variety of styles and sizes to satisfy the requirements of any installation.

ANCHOR COUPLING CO. INC.

389 North Fourth Street, Libertyville, Illinois

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FLUID POWER LINES

about hydraulics & pneumatics

FLUID POWER GOES TO SEA . . . In fact it *went* in 1906 when the Navy installed gun-elevating gear aboard the battleship West Virginia. Applications have increased, especially for cargo handling, carrier elevators, and submarine steering. But the commercial marine industry has been slower to take advantage of the force and control advantages of fluid power.

Two new ships promise more fluid power applications to come. They're Moore-McCormack's Argentina and Brasil which have a-c instead of traditional d-c electrical systems. A-c is cheaper, simpler to install, and easier to maintain, but it lacks the speed control ability of d-c for winches. The answer: a-c motors driving winch drums through hydraulic transmissions for stepless speed control. The winches are instantly reversible and have extremely fast acceleration and deceleration. They won't drop a load if power fails, and they won't pick it up if it's too heavy. Experience so far has been excellent. Let's see how fast electro-hydraulic winches become *the* standard.

LIFT DAT HATCH . . . Two stories in this Marine issue show new designs for lifting hatches. It's a job that hydraulics is taking over from the cranes. Compare the Swedish design using rotary actuators (p. 69) with the American design using cylinders (p. 86).

SILENT SERVICE . . . Part of America's defense depends on its ability to design for silence. A submarine can avoid sonar detection if it operates quietly. Much of this "quiet design" goes into its extensive hydraulic system. It takes some unusual techniques to cut noise. They're outlined in *Submarine Hydraulics . . . Designing for Safety & Silence.*

THE OLD ARMY . . . It used to be, a recruit worried most about keeping his rifle clean. Nowadays he's busy learning about missiles, electronic systems, and even ships. Two articles describe fluid power systems on a new Army landing craft. *Pneumatic Controls for Pitch and Speed* tells how a pressure control system actuates its vertical axis propellers. Another unusual feature of the ship is its pogo stick to push off from a beach. This high force cylinder system is discussed in *Hydraulic Pogo Stick Debeaches Landing Ship.*

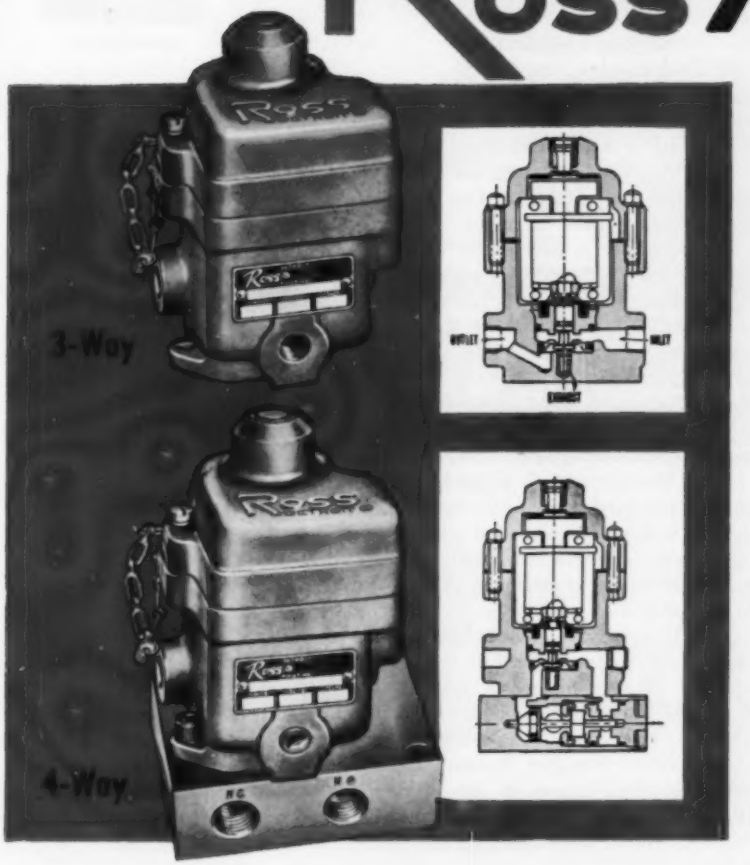
SAFER THAN SAFE . . . The need for fire-resistant fluid on a naval combat vessel is obvious. Not so apparent are other needs the Navy has for fluids it uses in its hydraulic systems. Toxicity is a hazard on submarines; fluids must not form harmful vapors which contaminate the ship's atmosphere. Other characteristics the Navy is developing and testing are discussed in *What the Navy Wants in Fire-Resistant Fluids* on page 82.

More Fluid Power Lines on page 10

Announcing

a new and better solenoid valve in the $\frac{1}{8}$" and $\frac{1}{4}$" size range

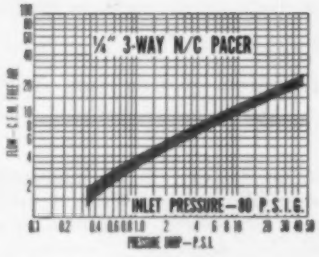
Ross PACER



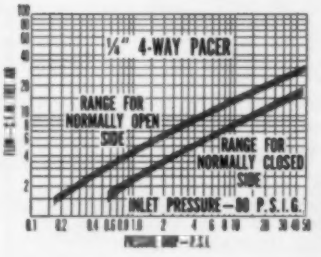
More life
More speed
More capacity
More value

Now you can have about three times more flow capacity-to-solenoid size than in most competitive valves. Needs just 7 watts of power yet minimum internal orifice size is full $\frac{1}{32}$". The PACER has short poppet travel, will cycle at better than 1000 cpm and meets JIC specifications. Lightweight, cast aluminum body means 3-way weighs just 20 ounces, 4-way just 28. Dust tight, liquid tight, can be manually actuated, has captive cover, is inoperative with cover removed, has integral wiring space. Why not test a PACER in your own circuit, just $18 for a 3-way, $26 for a PACER 4-way. Call your Ross representative or write for Bulletin 319.

Pressure drop thru 3-way N.C. Pacer valve under steady flow conditions. Inlet pressure 80 psig. Data shown as a range rather than as absolute values due to variables such as barometric pressure, manufacturing tolerances, etc.



Pressure drop thru both N.C. & N.O. sides of 4-way Pacer valve under steady flow conditions. Inlet pressure 80 psig. Data shows ranges for each side rather than absolute values due to variables such as barometric pressure, manufacturing tolerances, etc.



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MODERNIZE

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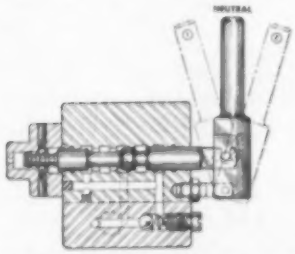
new 10,000 psi FOUR-WAY VALVES

effortless operation for applications up to 10,000 psi

Have valving problems on hydraulic applications calling for high pressures up to 10,000 psi? This new GREENLEE Four-Way Valve may be your answer. Simple, trouble-free spool-type valve . . . completely balanced to provide effortless operation at any pressure in any position. It operates with the same ease at 10,000 psi as at 0 psi. Panel mounted for universal adaptability. Subplate available. Precision-made, precision-tested. (Max. leakage 4 cu. in. per minute at 10,000 psi.) Write today for illustrated data sheet.



GREENLEE Four-Way Valve is available in two models: No. 1717 (above) with detent-positioned control lever . . . No. 1704 with spring-centered control lever.

THE GREENLEE LINE ALSO INCLUDES A WIDE SELECTION OF HAND AND POWER-OPERATED HYDRAULIC PUMPS

GREENLEE

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FLUID POWER LINES

OLD ORDER CHANGETH . . . Just twelve years ago this month a new magazine called APPLIED HYDRAULICS made its bow. Writing its first editorial, publisher Irving B. Hexter stated its purpose: to demonstrate to management executives efficiencies and advantages of fluid power, to show design engineers how hydraulic and pneumatic components and systems are used effectively, and to tell maintenance men how to keep equipment running at peak efficiency.

Paul Rolnick

Allan Morris

That has been the editorial policy ever since. One of its most prolific administrators has been Paul Rolnick who joined the magazine's staff in 1950 and became editor five years later. With a mechanical engineering degree in one pocket and a flair for writing in the other, he developed the magazine as an integral part of the industry it serves.

Robert Shattuck

Jack Lowery

Now Paul takes on new responsibilities as vice president and publishing director of Industrial Publishing Corp., publisher of APPLIED HYDRAULICS & PNEUMATICS and nine other magazines. His duties will be to work with each editorial staff, adding his experience and talents to strengthen editorial content and presentation.

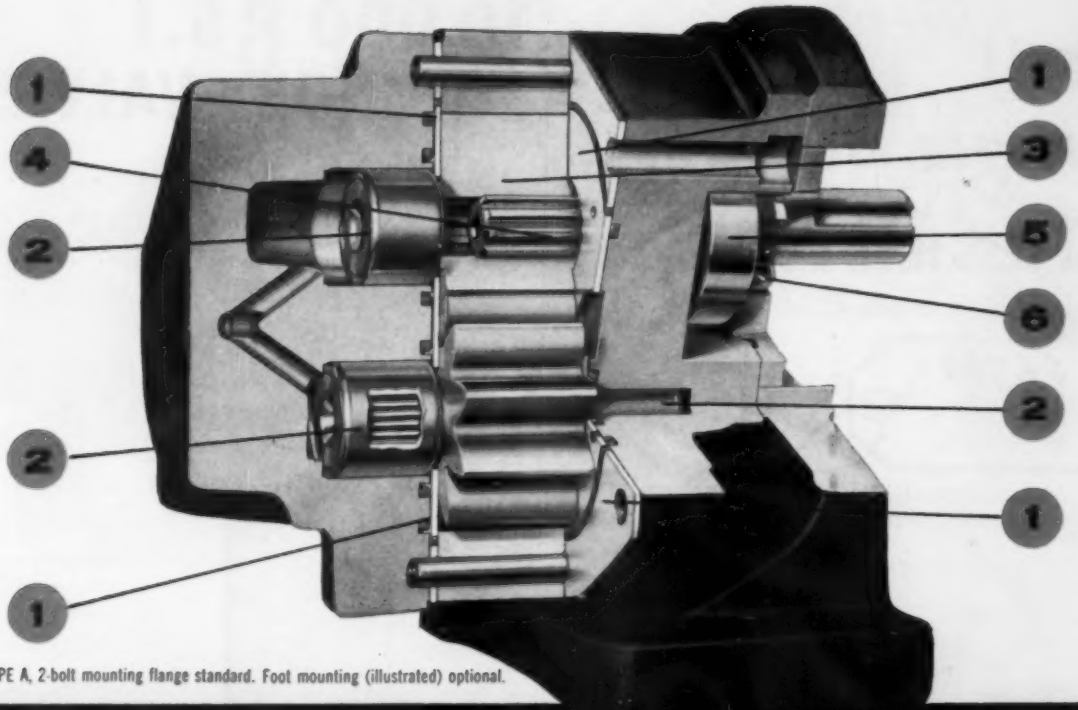
Allan Morris succeeds Rolnick as editor. He came with AH&P in 1955 and has prepared many of the special features appearing since then. These include a series on electrical controls, and reports on mobile equipment components, temperature control, water hydraulics, and air valves. Allan has an electrical engineering degree and teaches a hydraulics course at Fenn College.

Jack Lowery who joined AH&P in 1958 becomes associate editor. A mechanical engineer, he has extensive experience in fluid power components. One of his recent projects was last month's Designer's Guide issue which charts specifications for 34 hydraulic and pneumatic components. Jack is also responsible for AH&P's pneumatic coverage.

As business manager, Robert Shattuck will guide the magazine's sales activities. Well known to fluid power component manufacturers in the Ohio, Michigan, Pennsylvania area, Bob has represented the magazine for eight years. His experience includes 17 years in industrial sales.

Want to share $1400 in Applied Hydraulics & Pneumatics Prize Paper Contest?

You can if you've worked on an interesting hydraulic or pneumatic design. Write it up telling what the original objectives were and how they were achieved. Tell what basic problems were involved and how they were solved. Include drawings and photos to explain what was done. Make a start now by circling No. 240 on the time saver card in this issue.



SAE TYPE A, 2-bolt mounting flange standard. Foot mounting (illustrated) optional.

SAVES UP TO 4 HORSEPOWER!

NEW WEBSTER "J" SERIES HYDRAULIC PUMP

HERE'S HOW WEBSTER PUTS NEW EFFICIENCY IN HYDRAULIC POWER . . . .

1 PRESSURE BALANCED WEAR PLATES — for high volumetric efficiency; prevents clearance changes due to heat.

2 NEEDLE BEARINGS — power-saving, anti-friction operation.

3 ONE PIECE GEAR AND BEARING JOURNAL UNITS — assure minimum deflection and proper alignment on both drive and idler assembly.

4 FREE-FLOATING INTERNAL SPLINE DRIVES - no key failures.

5 THRUST BEARING ON DRIVE SHAFT — absorbs compound driving thrusts.

6 DOUBLE LIP SEAL ON DRIVE SHAFT — gives added protection against seal failure and dirt.

Now — hydraulic power for your biggest mobile rig and the toughest jobs you can put it on. Webster's new "J" pump delivers 2000 psi — does it on less fuel and saves up to 4 horsepower in the bargain!

It's the result of a combination of pressure balanced wear plates and anti-friction bearings. Here's top efficiency from all-new Webster design that rates 10% or more above others in competitive ratings. Moreover, you get equally important advanced features (see sectional view) to assure dependable, trouble-free service.

Webster "J" series pump is trim, *very compact* — fits into tight quarters, mounts easily. It's available in 10 sizes from 5 to 40 gpm. Ask your Webster Electric representative for all the facts on this powerful new pump — or write direct for Bulletin HY1-1.

OIL HYDRAULICS DIVISION

WEBSTER ELECTRIC

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NEW!

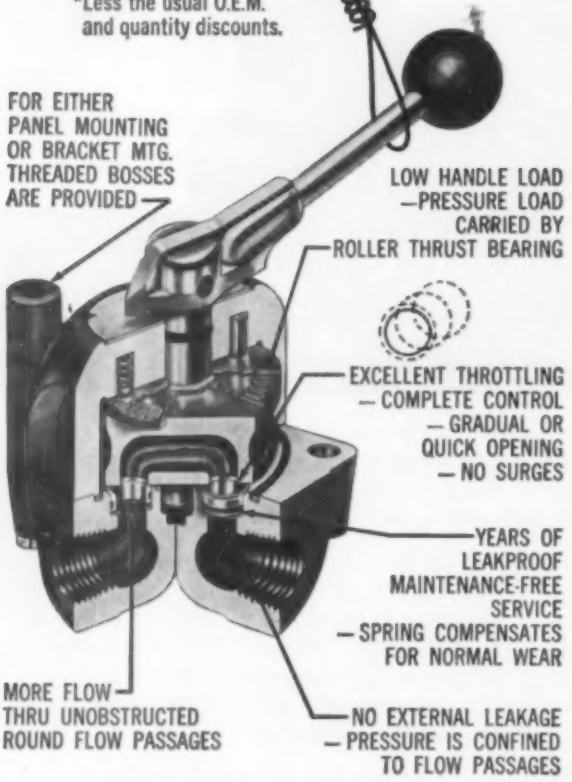
A "SHEAR-SEAL" VALVE

for LESS than a spool valve

RATED FOR 3000 P.S.I. OIL SYSTEMS

$65.00
List Price*
for a ¾" valve

*Less the usual O.E.M. and quantity discounts.


FOR EITHER PANEL MOUNTING OR BRACKET MTG. THREADED BOSSES ARE PROVIDED
LOW HANDLE LOAD —PRESSURE LOAD CARRIED BY ROLLER THRUST BEARING
EXCELLENT THROTTLING — COMPLETE CONTROL — GRADUAL OR QUICK OPENING — NO SURGES
YEARS OF LEAKPROOF MAINTENANCE-FREE SERVICE — SPRING COMPENSATES FOR NORMAL WEAR
MORE FLOW THRU UNOBSTRUCTED ROUND FLOW PASSAGES
NO EXTERNAL LEAKAGE — PRESSURE IS CONFINED TO FLOW PASSAGES

For complete data on this new valve and for information on all your valve requirements write for Catalog V-59-60

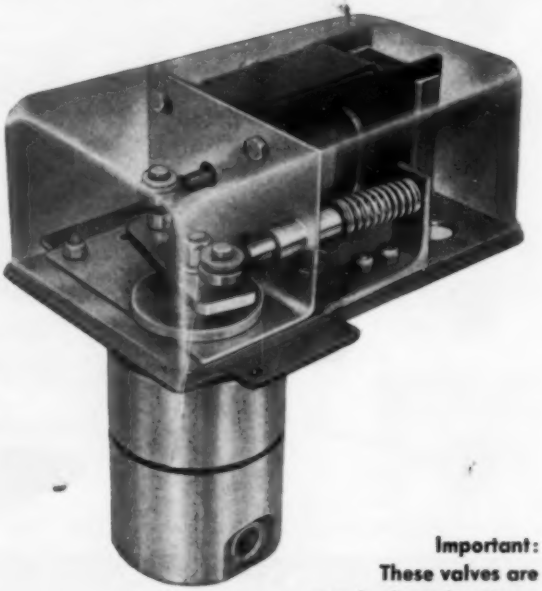
CONTROL VALVE DIVISION

Barksdale valves

5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA

12 Circle **19** on Time-Saver Card

10,000 P.S.I. SOLENOID VALVES



Important: These valves are standard catalog items.

● They are available for immediate delivery (in stock) at standard valve prices, for a service which generally requires costly (made-to-order) special valves.

● Shut off and 4-way valves in ¼, ⅜ and ½ inch port sizes are rated for 10,000 P.S.I. liquid or gases. They will withstand surges of up to 15,000 P.S.I. without damage to the valves' sealing qualities (designed for a burst pressure of 30,000 P.S.I.).
Solenoids are available for 115, 230 and 460 volt A.C. operation.

● Long maintenance-free service is achieved through the leak-proof "Shear-Seal" design. Optically flat metal to metal sealing surfaces (of the self-aligning sealing rings and the mating rotor face) are protected by staying in constant intimate contact: flow is always through the center of the "Shear-Seals," never across sealing surfaces. Sealing qualities actually improve as the seals lap themselves to a more perfect fit with each valve operation. There is no external shaft leakage because the pressure is confined to the flow passages.

For complete data write for catalog S-10000.

CONTROL VALVE DIVISION

Barksdale valves

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Circle **20** on Time-Saver Card

Circle **93** →

low cost
product
insurance

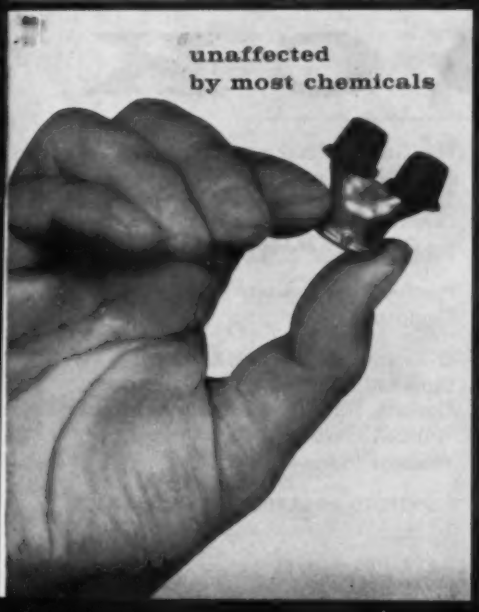
easy to apply

won't chip,
break, shred
or collapse

made of tough,
flexible Polyethylene

Caplugs

take your pick: over 600
sizes in numerous styles
and colors now in stock.



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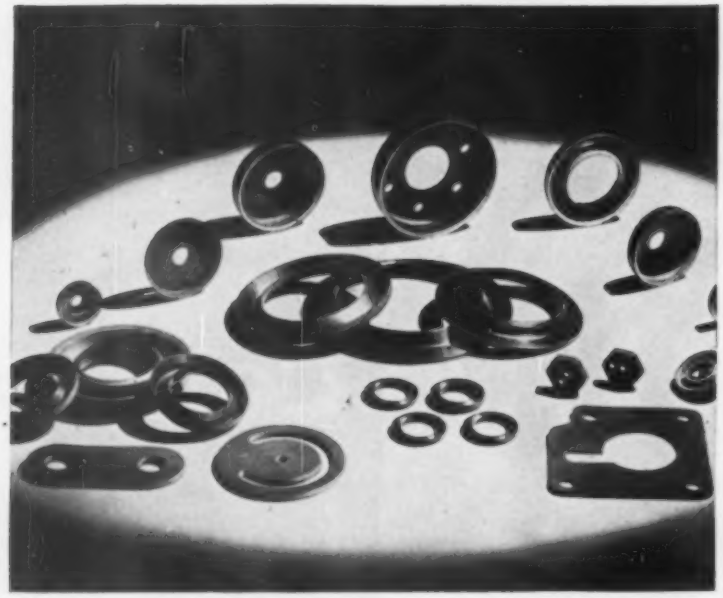
MECHANICAL LEATHERS in Design Engineering



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Garlock Mechanical Leathers—being of steerhide—have an unmatched tensile strength and toughness. Also, leather packings have a low coefficient of friction, minimum cold flow. They provide extremely good resistance to abrasion and wear . . . actually tend to polish metal surfaces which they contact!

Garlock leather packings can be impregnated for a variety of hydraulic applications. For example, they can be made soft and flexible for low pressures; semi-rigid for intermediate pressures; firm for high pressures.

Cold and hot water, oils, air, gas, oxygen, alcohol, glycerine, gasoline, kerosene, and other non-caustic fluids will not harm leather packings. They can be used in temperatures from sub-zero to +200° F. Garlock leather packings are suitable for pressures from a few ounces to many thousands of pounds per square inch.

In any of three leathers—BITAN*, Chrome, or Oak—Garlock can furnish all shapes, sizes, materials and designs of leather packings for hydraulic use. They're made in a modern packing plant which maintains highest standards of quality. Molded Cups, "U" Packings, "V" Packings, Washers, Gaskets, Discs, Flange or Hat Packings are some of the more commonly specified types. Sizes range from ⅛" O.D. leather washers for needle valves to 99" O.D. "U" Packings for heavy duty hydraulic service.

Contact your Garlock representative at the nearest of our 26 sales offices and warehouses throughout the U. S. and Canada. Or, write for Catalog AD-121,

GARLOCK

The Garlock Packing Company, Palmyra, New York.

Canadian Division: The Garlock Packing Company of Canada, Ltd.

Plastics Division: United States Gasket Company.

Order from the Garlock 2,000 . . . two thousand different types of Packings, Gaskets, Seals, Molded and Extruded Rubber, Plastic Products

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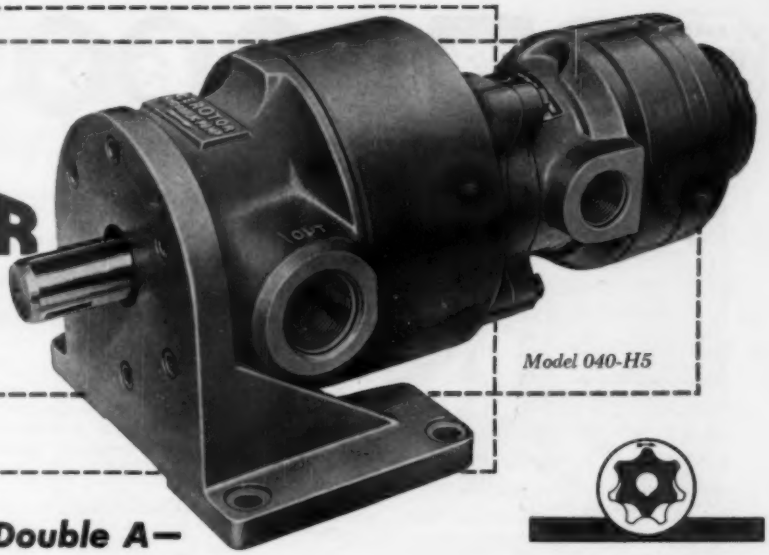
NEW GEROTOR PUMP



Model 040-H5

From Brown & Sharpe/Double A—

Tandem Combinations of Large & Small Pumps

Here's a new line of compact tandem hydraulic pumps, with a choice of fifteen different total flow rates. These Gerotor O-H pumps are separately piped (but commonly mounted) combination pumps that have two pump sections of varying capacities, mounted in tandem. Three size ratings are offered in the larger of the two pump sections. One of four smaller capacities is selected for the second section.

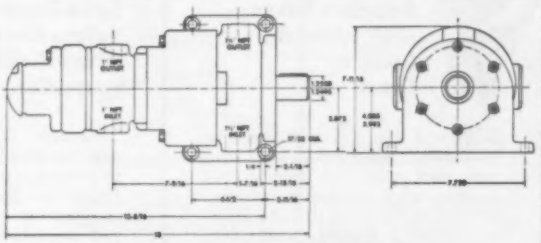
O-H pumps may be ordered for use with non-flammable fluids. This 800 series modification is fast becoming the industry standard for fire-resistant fluid services. Pressure rating on these pumps is 1000 psi, on a continuous duty basis. When ordered for use with standard hydraulic oils, the pressure rating is 1500 psi. Volumetric efficiencies average an impressive 91%.

The actual fluid delivery of all but the largest rated pump in each section is substantially increased by operating at 1800 rpm instead of the usual 1200 rpm. The table shows the sizes available in both the 'O' and 'H' sections, and actual deliveries at both speeds. O-H pumps have a minimum speed of 200 rpm.

OPERATING SPEED (RPM)	O-H PUMP FLOW RATES (ACTUAL GPM)						
	O Section Ratings			H Section Ratings			
	20	30	40	3	5	8	12
1200	20	31	44	3	5	8	12
1800	30	45		4.7	7.7	12.8	

The use of the higher 1800 rpm speed affords an important economy in the cost of the electric motor. The difference in cost between 1200 and 1800 rpm motors of the same horsepower more than covers the cost of the O-H hydraulic pump it will drive.

Gerotor O-H pumps utilize the Gerotor principle of operation, resulting in these important qualities: smooth, uniform fluid flow; long pump life with either standard or fire-resistant hydraulic fluids, and high volumetric and mechanical efficiency.



GET COMPLETE INFORMATION

On Gerotor O-H model tandem pumps

ASK FOR the O-H Pump catalog sheet

All the pumps and motors in the Gerotor line are rugged, efficient, dependable products. They last longer, especially with low-lubricity, non-flammable fluids. Flow capacities are from .42 to 43 gpm with pressures to 2000 psi. Ask about them soon.

Take advantage of Double A hydraulic developments. Contact your nearest Double A hydraulic distributor. Or write to **Double A Products Co.**, a subsidiary of Brown & Sharpe Mfg. Co., Manchester, Michigan.

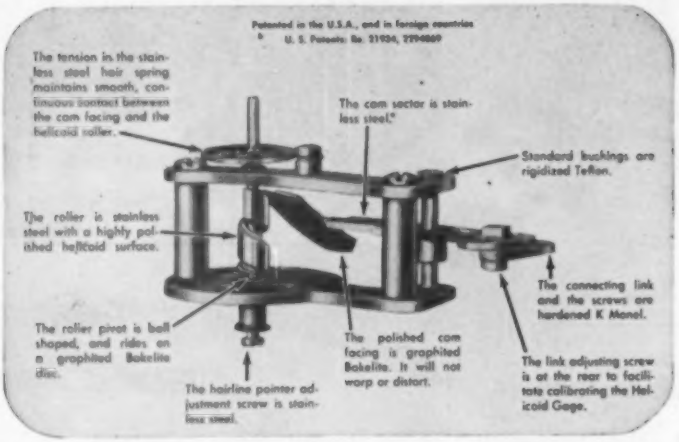
Brown & Sharpe

HYDRAULICS DIVISION

GEAR, VANE & CENTRIFUGAL PUMPS
DOUBLE A VALVES
GEROTOR PUMPS
POWER UNITS

B·S

PROGRESS IN PRECISION FOR OVER 125 YEARS


Patented in the U.S.A., and in foreign countries
U. S. Patents: Re. 21936, 2794869
The tension in the stainless steel hair spring maintains smooth, continuous contact between the cam facing and the helicoid roller.
The cam sector is stainless steel.*
Standard bushings are rigidized Teflon.
The roller is stainless steel with a highly polished helicoid surface.
The connecting link and the screws are hardened K Monel.
The roller pivot is ball shaped, and rides on a graphited Bakelite disc.
The polished cam facing is graphited Bakelite. It will not warp or distort.
The link adjusting screw is at the rear to facilitate calibrating the Helicoid Gage.
The hairline pointer adjustment screw is stainless steel.

Exclusive Helicoid movement provides...
Sustained Accuracy...on the toughest jobs

• Helicoid Gages have no gears, no teeth, reducing wear to an absolute minimum. No danger of fouling, either—rolling action of cam facing keeps contact surface clean. Helicoid Gages have been tested through 75,000,000 cycles, with virtually no wear or loss of accuracy, while conventional geared gages became useless after 500,000 cycles.

Helicoid Gages give *sustained* accuracy even when subjected to violent pressure pulsations or mechanical vibrations. Pointer can be set externally, without removing glass, and cannot be jarred out of position. Dial faces are easy to read, won't corrode or chip. A full range of Helicoid Gages is available for any application. Next time, specify Helicoid—the gage that *stays* accurate.

Bourdon Tubes won't Stretch, Leak, or Crack

Helicoid Bourdon tubes are made from seamless tubing, and are designed for maximum torque and minimum stress. At the factory, each tube is individually tested, overpressured, and stress relieved. Four materials—alloy steel, K Monel, stainless steel, and phosphor bronze—are available to meet applications ranging from tap water to almost any acid.

NEW! Solid-Front Safety Case Gives Added Protection

The new Helicoid solid-front case diverts the force of a burst in a backward direction, away from the operator. The force escapes by deforming, though not detaching, the back cover plate. Helicoid Gages are also available in phenol, acaloy flanged, acaloy flangeless, polished flangeless, round flush, polished flush ring, and square flush cases.

Distributed in Canada by
Upton, Bradeen & James, Ltd.
Quebec, Montreal, Ottawa, Toronto, Hamilton, Windsor, Winnipeg, Edmonton, Vancouver

WRITE for details

Ask for Catalog DH-65

HELICOID GAGES

Helicoid Gage Division • American Chain & Cable Company, Inc.
929-H Connecticut Ave., Bridgeport 2, Conn.

ACCO

Circle **62** on Time-Saver Card

LETTERS to the editor

Address your letters to: Editor, APPLIED HYDRAULICS & PNEUMATICS MAGAZINE, 812 Huron Rd., Cleveland 15, Ohio.

Preparation for Fire Resistant Fluid

TO THE EDITOR:

We read with interest your article "How Fire Resistant Fluids Are Used Today" in the November issue. We understand there is a method now in use for flushing scale and dirt from the interior of a newly assembled, closed hydraulic system without dismantling the system and cleaning each part separately. The system in question would employ a FR fluid.

Along with any information on this subject, we would appreciate the names of any companies equipped to do this work.

N. L. SHAGALOFF
Swindell-Dressler Corp.
Pittsburgh, Pa.

We're not aware of a special method for flushing scale and dirt. There should be very little of it in a new system. We've sent you names of a builder of hydraulic power units and a supplier of fire-resistant fluids. Their experience should be valuable in working out a procedure.

Flow Divider Inquiry

TO THE EDITOR:

Referring to the article, "Single Unit Divides Flow Equally" in the December issue, we would appreciate information pertaining to the manufacturer, physical dimensions, power and flow characteristics, and technical data of the gear type, positive displacement flow divider described in the article.

JOHN GAYDOS
Lester Engineering Co.
Cleveland, Ohio

Name of the manufacturer has been sent. ▼▼▼

Eastman first to be specified by America's leading OEM's...

A COMPLETE LINE TO CHOOSE FROM FOR YOUR PARTICULAR APPLICATION

Available in all thread styles and sizes

Permanently Attached Male (NPTF) for 1, 2 and 3 Wire Braid rubber cover hose. Plated to prevent rust and corrosion.
Sizes: ¼" thru 2".
Wkg. Press.: 375—5000 p.s.i.

Permanently Attached Male Flare (JIC) for 4 and 6 Spiral Wire Braid rubber cover hose. Used for Ultra High Pressure.
Sizes: ½" thru 1½".
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Reusable Male (NPTF) for cotton and rubber cover hose. No skiving necessary.
Sizes: ¼" thru 2".
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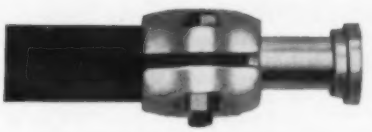
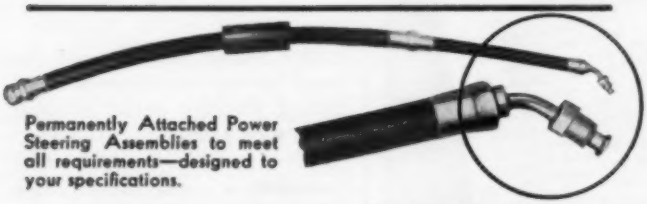
Reusable Swivel Female for 1 and 2 Wire Braid rubber cover hose. Easy field replacement.
Sizes: ¼" thru 1¼".
Wkg. Press.: 375—5000 p.s.i.

Permanently Attached Flange Head Couplings for 1 and 2 Wire Braid rubber cover hose. Available in angles to 90°.
Sizes: ½" thru 2".
Wkg. Press.: 375—5000 p.s.i.



Clamp Type Couplings with split flange stems for 1 and 2 Wire Braid rubber cover hose. Exclusive "Inter-Lock" feature.
Sizes: ½" thru 2".
Wkg. Press.: 375—5000 p.s.i.



Permanently Attached Power Steering Assemblies to meet all requirements—designed to your specifications.

Permanently Attached Air Conditioning Assemblies for automotive use—designed to your particular specifications.

It's a known fact that many leading Original Equipment Manufacturers submit their original specifications for their *first* quotation to Eastman.

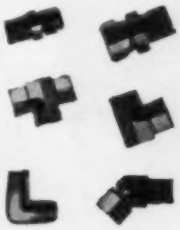
EASTMAN's unequalled experience in hydraulic conversion, plus many original designs shown in a few popular Eastman fittings at the left—give your product an appearance of quality that improves its competitive position. These assemblies are available in all thread styles and sizes.

EASTMAN Engineering Service... Backed by Unequalled Experience

It is also a known fact that Eastman's co-operative engineering counsel and service is highly respected and often requested by leading OEM's. Let Eastman engineers help you lay out your fluid power lines—from pump to point of work—effecting economies in design, improving performance and increasing user satisfaction.

Let EASTMAN recommend the *best assembly . . . for the best performance . . . at the lowest cost.*

Bent Tubing with the necessary fittings to meet your own specific requirements.



Adapters, Adapter Unions and Boss "O" Ring Fittings. All types and sizes available.

FOR ADDITIONAL INFORMATION, WRITE EASTMAN MFG. CO., MANITOWOC, WISCONSIN OR PHONE: MURRAY 4-4495

Eastman *first in the field*

MANUFACTURING COMPANY
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MANITOWOC, WISCONSIN

WRITE for Eastman Technical Bulletins Nos. 100 and 200 on High, Medium and Low Pressure Hydraulic Hose Assemblies.

LOW
COMPRESSION
SET
BUTYL!
TECHNICAL MEMO ON LINEAR COMPOUND 7806-70
. . . for O-rings, U-cups and V-rings
• contains Butyl with low compression set plus cold flow properties comparable to other elastomers
• excellent ozone resistance, impermeable to gases
• effective sealing from –65° to +212°F
FLUIDS COMPATIBLE WITH Compound 7806-70
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Aniline • Cellulbe • Cinnamon Oil • Cresol • Diethylene Glycol
Diethyl Phthalate • Furfural • Furfuryl Alcohol • Glycerine • Houghto
Safe 271 • Hydrochloric Acid, dilute • Methyl Ethyl Ketone • MIL-H-
19457 • Mobil Nyvac No. 20 • Mobil Nyvac No. 30 • Nitric Acid,
dilute • Nitrobenzene • Oronite 8200 • Ozone • Dimethyl Foramide
Ethyl Acetate • Ethylene Glycol • Ferric Chloride • Fluorolube GR 362
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Skydrol • Sod. Hydroxide • Sulfuric acid, dilute • Triethanolamine
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For full technical data—including a list of incompatible fluids, write today for Technical Bulletin No. 56701-1. Linear Inc., State Road and Levick Street, Philadelphia 35, Pa.
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FLUID POWER FORUM

Each month APPLIED HYDRAULICS & PNEUMATICS surveys readers for their experiences and opinions in fluid power design.

- *How much help would information on pressure drop through a directional valve be to you?*

I am interested in information on pressure drop through directional control valves. Methods of calculation should consider oil viscosity temperature, and compressibility. It would also be useful to discuss methods of holding this pressure drop to a minimum.

H. SCHRAMM
Hydraulic Engineer
Rockford Machine Tool Co.
Rockford, Ill.

- *What is your practice in installing air pressure regulators? One for each cylinder? One for the whole machine? What are your reasons for this? How does it help you maintain better pressure control? What problems do you have with pressure regulators?*

If the situation warrants, we use a regulator for each cylinder to gain individual control and divide the pressure drop among all the cylinders.

J. HENDERSON
President
Henderson Engineering Co.
Chicago, Ill.

Our biggest problem with the usual low cost regulators is maintaining constant output pressure when supply pressure varies. On a complex system, I would consider installing a good, master regulator to hold regulated supply constant.

W. C. ANTRIM
Engineer
Allied Chemical Corp.
Syracuse, N. Y.

We use a regulator for each system where combined operation of systems is random. This permits a

Continued on page 20

Circle 87 →

. . . Fluid Power news

REPORT NO. 11,704
Power and Control for New Lock Gates

From Oilgear Application-Engineering* Files

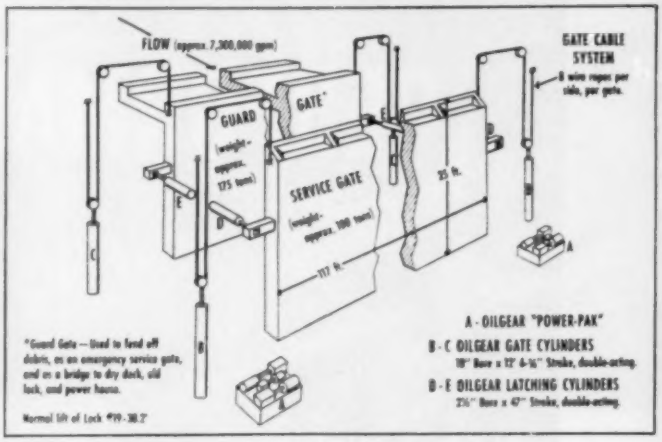
HOW OILGEAR AE* HELPS THE ARMY ENGINEERS SPEED MISSISSIPPI RIVER TRAFFIC

CUSTOMER: *Corps of Engineers, U. S. Army, North Central Division, Rock Island District*

DATA: Power and control system for lifting, lowering, and latching the 110-ft, single leaf, vertical lift, upper service and guard gates on new 1200-ft Mississippi River Lock #19 at Keokuk, Iowa.

REQUIREMENTS: 1. Foolproof, dependable, fast operation. 2. Simple, automatic, three-speed control from central station, interlocked electrically with lower miter gate, tainter valves, and lock water level. 3. System must incorporate: (a) Automatic latching, (b) Skew control to keep gates level during lifting and lowering, (c) Provision for emergency closing, (d) Automatic positioning for controlled supplemental fill of lock chamber over service gate top, (e) Additional lift-travel for cable and seal servicing, (f) "Fail-safe" operation in event of power failure.

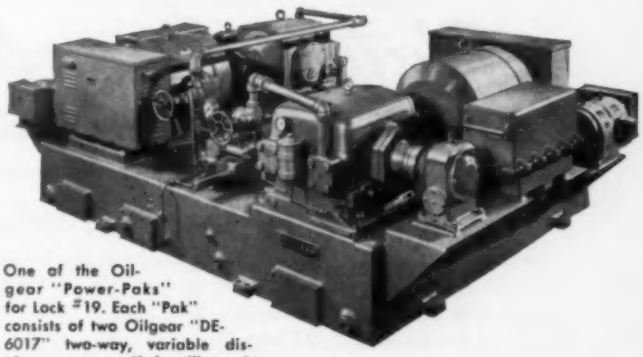
A typical "tow" entering new Lock #19 from upstream. In "locking-down" it will pass over the Oilgear-powered upper guard and service gates. Several "tows" can simultaneously "lock-thru" intact. New upper guard gate also serves as an access bridge to a dry dock and the old lock visible to the right of the new lock.


FLOW (approx. 7,300,000 gpm)
GATE CABLE SYSTEM
8 wire ropes per side, per gate.
GUARD
(weight—approx. 175 tons)
GATE
SERVICE GATE
(weight—approx. 180 tons)
25 ft.
117 ft.
A
B
C
D
E
"Guard Gate—Used to fend off debris, as an emergency service gate, and as a bridge to dry dock, old lock, and power house.
Normal lift of Lock #19-38.2'
A - OILGEAR "POWER-PAK"
B - C OILGEAR GATE CYLINDERS
18" Bore x 12' 6-½" Stroke, double-acting.
D - E OILGEAR LATCHING CYLINDERS
2½" Bore x 47" Stroke, double-acting.

SOLUTION: An Oilgear *Application-Engineered* Fluid Power System which surpasses all originally specified requirements . . . as shown above in simple schematic form. This system consists of two Oilgear "Power-Paks" (A), four Oilgear custom, double-acting gate cylinders (B-C) — with integral solenoid pilot-operated brake valves, and four Oilgear custom, double-acting gate-latching cylinders (D-E). Entire upper gate control system is interlocked electrically with the lower miter gate and tainter valves for maximum operating safety. In event of power failure, solenoid pilot-operated brake valves, integral with cylinders, stop gate movement for "fail-safe" operation. Automatic skew control prevents "cocking" or binding of gates. A difference of 1½" in side height automatically reduces displacement of leading gate cylinder pump to allow lagging cylinder to catch up. Gate "down-cycle" power regeneration is an outstanding "Oilgear-plus" feature that furnishes exceptional electric power economy . . . utilizes the downward load on cylinder fluid to drive the Oilgear pumps as motors, reducing electrical power input. To speed lock filling, upper service gate automatically lowers to a supplementary fill position permitting controlled flow of water over gate top. Gate holds this position until water levels of upper pool and lock chamber are equalized, and automatically proceeds down at high speed. If water levels are equalized prior to start of cycle, gate does not stop at supplementary position. "Fill" time is only 10 minutes, drain time — 9¼ minutes. Entire "lock-thru" time for an 11-barge tow has been reduced from 7¼ hours to approximately 20 minutes with this new lock. In emergencies, upper gates can be raised or lowered against full river flow. Oilgear *Application-Engineered Controlled Motion Systems* are simplest to install, operate, and maintain . . . require less power to operate, reduce installed costs . . . are complete systems for specific applications — with one responsibility for the entire system.

* * *

Similar Oilgear systems are operating the St. Lawrence Seaway Eisenhower Locks, the Monongahela River Locks, the Bayou Boeuf Locks, the Dalles Locks, the McNary Lock — all projects of the Corps of Engineers . . . as well as operating miter gates, tainter valves, capstans . . . shipboard steering and flanking gear, winches, catapults, elevators, mobile oil drilling barges, and in all phases of industry.



One of the Oilgear "Power-Paks" for Lock #19. Each "Pak" consists of two Oilgear "DE-6017" two-way, variable displacement, radial rolling piston pumps coupled to 50-hp electric brake-motors; two electric pilot gearmotors, reducers, limit switch boxes, and right angle worm-gear drives to pump controls. Also included are a manually operated Oilgear change-over valve, an Oilgear "HG" constant displacement axial piston pump for operating the latching cylinders — all on a custom oil reservoir base . . . completely wired and piped, ready for installation. Each Oilgear variable displacement pump is piped to one of the large gate cylinders. In the event that pump maintenance or inspection is required, the manual change-over valve permits either pump on the "Pak" to be idle while the other pump operates either the service or guard gate.

for the lowest cost per year . . . it's Oilgear!

For practical solutions to YOUR rotary or linear drive and control problems, call the factory-trained Oilgear Application-Engineer in your vicinity. Or write, stating your specific requirements, directly to . . .

THE OILGEAR COMPANY
Application-Engineered Controlled Motion Systems
1564 WEST PIERCE STREET • MILWAUKEE 4, WISCONSIN

QUALITY THAT PRODUCES TOP PERFORMANCE

FIXED BUNDLE

Yates-American

HEAT EXCHANGERS

- Flanged baffles . . . pioneered by YA eliminate vibration wear and provide maximum efficiency.
- Rolled tube joints . . . industry accepted standard of quality construction.
- Single and Multiple Pass Designs . . . available in 2" through 10" diameters.
- Now available from stock.
- Ask for Bulletin HT-1A.

ENGINE COOLING RADIATORS

Over 75 years of service to industry

HEAT TRANSFER DIVISION

Yates-American

MACHINE COMPANY

705 4th St. BELOIT, WISCONSIN

Circle **127** on Time-Saver Card

FORUM

narrow range for the flow demand placed on each regulator. Generally a narrower range of flow demand results in less pressure variation due to flow.

F. A. GROSS
Chief Engineer
Industrial Measurements
Pomona, Calif.

We use one regulator for each cylinder to avoid interaction effects and to provide capacity necessary for peak demands.

T. H. LOTZE
Application Engineer
Minneapolis-Honeywell
Ft. Washington, Pa.

We use air regulators in three ways:

a. One full line size regulator per circuit, if the cfm demand can be met.

b. One regulator per cylinder, where different and varying demands are required of the individual cylinders in the circuit.

c. One regulator (self-relieving type) per circuit, used as an air spring (cylinder return) assuming all cylinders require the same return pressure.

We prefer to use one regulator of ample size in the supply line, because it simplifies the installation and aids in keeping the circuit air relatively dry.

We have found that when a regulator is used between the control valve and the cylinder, there is a possibility of its hanging up when the valve calls for exhaust. In these applications, we usually place a check valve around the regulator to insure exhaust of the cylinder.

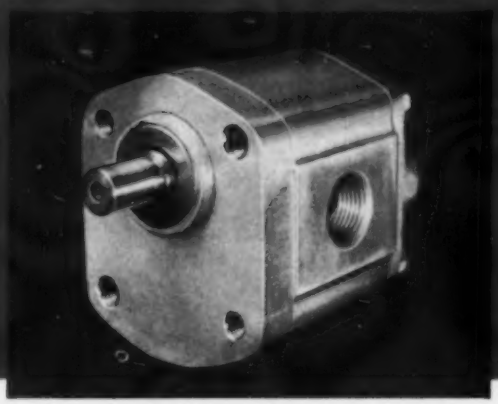
Where the pressure reduction is great, we normally use two or more units to step down the pressure and maintain reasonable accuracy. Regulators give very little trouble. However, their ratings, accuracy, and response time vary considerably among manufacturers.

R. F. HANLEY
President
Circuit Engineering, Inc.
Jacksonville, Florida

From WOOSTER Engineering...

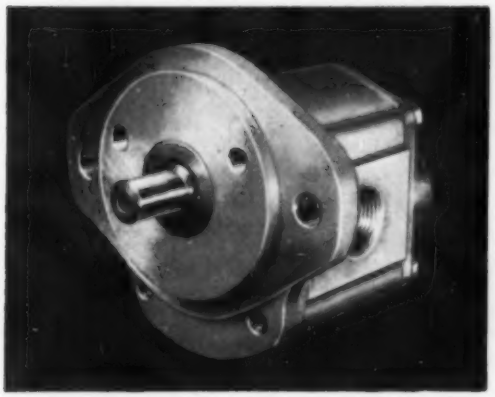
A NEW FAMILY OF B-W HYDRAULIC GEAR PUMPS

- GREATLY SIMPLIFIED
- LONGER LIFE
- HIGHER PERFORMANCE



Series P-2 Pump has finished its test runs with flying colors. Other series will move oil at a fraction of a gallon per minute to more than 100 GPM.

P-2 SERIES:
Capacities 1.7 to 7.8 GPM at 2000 RPM
Displacement 0.2 to 0.9 cu. in.
Pressure 2000 PSI
Speeds to 4000 RPM



Series P-2 Pump with standard S.A.E. 2-bolt magneto mounting.

The Most Efficient Hydraulic Gear Pumps Ever Produced by Wooster Engineers

"Designed and built by Wooster" has always meant the BEST. Borg-Warner pumps and valves have been used in an endless variety of applications throughout industry.

But this new pump gives outstanding performance. Pressure from the outlet port is used to reduce clearance between bearing faces and gears, giving optimum volumetric efficiency. New features: Special alloy tin-aluminum bearings, used in the heaviest-duty industrial engines . . . all bearings interchangeable . . . double lip shaft seal . . . hardened and ground steel gears and shafts . . . high quality, high tensile aluminum bodies for light weight.

A Variety of Porting, Mounting and Drive Arrangements To Serve Your Needs—Consult Our Engineers

WOOSTER B-W DIVISION

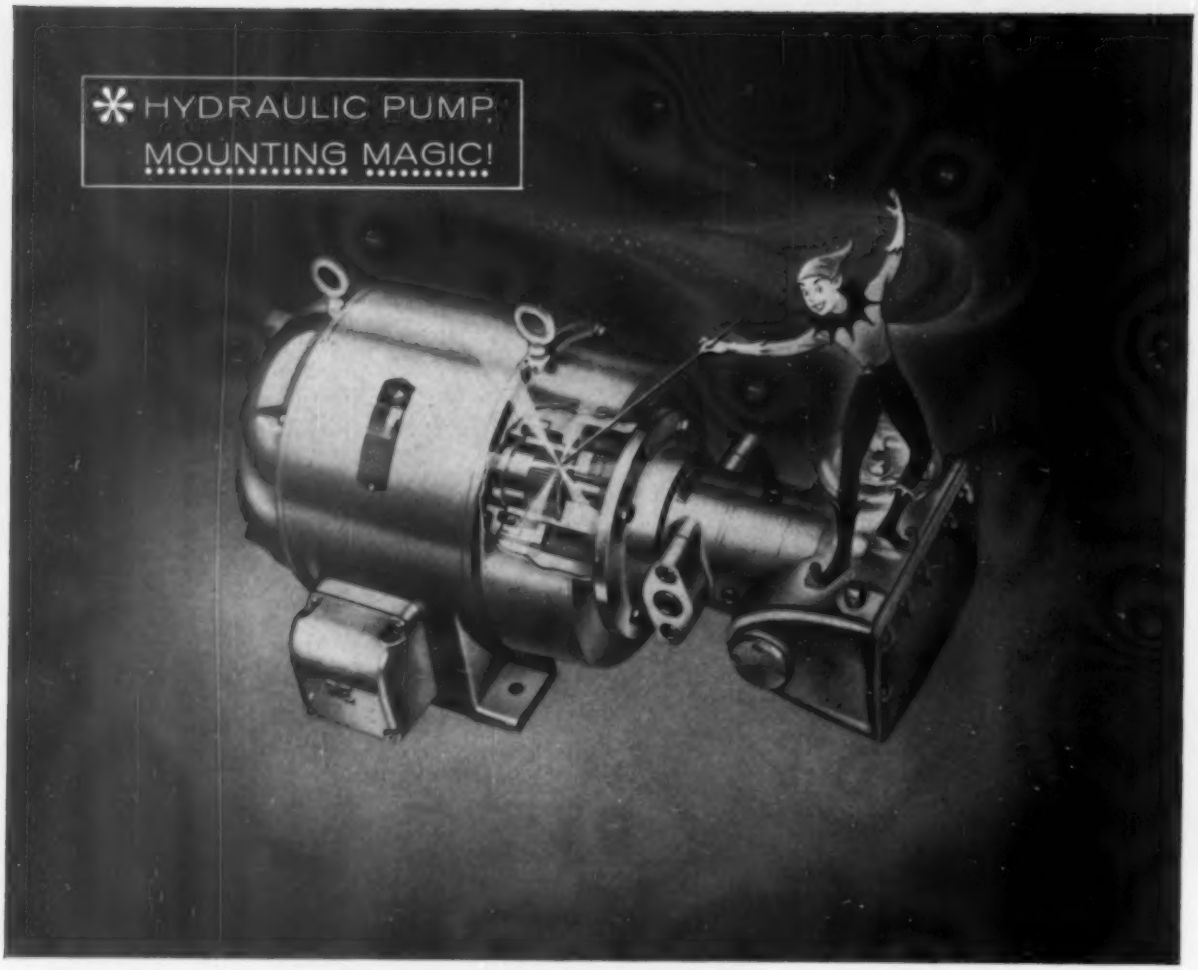
WOOSTER DIVISION

BORG-WARNER CORPORATION, WOOSTER, OHIO

INDUSTRIAL HYDRAULICS

EXPORT SALES—BORG-WARNER INTERNATIONAL • 36 SOUTH WABASH AVE., CHICAGO 3, ILL.

Circle **125** on Time-Saver Card



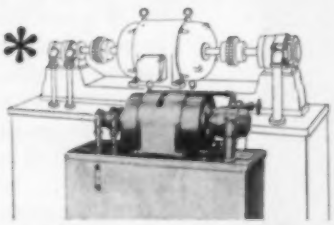
REULAND spline-coupled hydraulic pump mount motors

...CUT SPACE NEEDS ALMOST 50%... AVAILABLE *NOW* IN ½ H.P. THROUGH 50 H.P.!

Pump and motor become *one* with the new Reuland spline-coupled hydraulic pump hook-up. The pump shaft is connected directly to the motor's shaft *inside the motor*. Flexible couplings are eliminated... pump mount platforms are eliminated... and the tank length can be reduced because almost 50% less mounting area is required. Compact appearance is beautiful.

SPEEDY INSTALLATION

Pump-to-motor hook-up is merely a matter of seconds. All you do is slip the spline coupling onto the pump shaft... and attach the pump to the endbell. This spline coupling is supplied with the motor and is precision mated for each make of pump. There's no time wasted tinkering around... takes only a fraction of the ordinary time.



PRECISION ALIGNMENT

Alignment is perfect *automatically* whether the installation is made out in the field or on the production line. This permits even unskilled workmen to handle this simple task without error. Also, by hooking the pump up at the point of bearing support, within the motor, vibration is reduced to a new minimum. Operation is smooth, quiet.

COSTS LESS... SAVES INSTALLATION LABOR... FITS ALL PUMPS... FILLS ALL POWER NEEDS—

½-50 H.P. The Reuland spline-coupled unit is priced lower than a conventional set-up ... saves you extra money by reducing installation costs. What's more, we can supply it to fit any make of pump you may be using... and to your *exact* power needs, from ½ h.p. through 50 h.p. So sure are we that it will be of help to you, we are offering to engineer a demonstration unit to your equipment, without the slightest obligation. These units are our best salesmen.

Our New General Catalog Will Come In Handy—Sent Free on Request.

Refer to Sweet's Product Design File, Section 5a

MODERN POWER FOR MODERN-DAY PRODUCTS

REULAND MOTORS

REULAND ELECTRIC COMPANY
WESTERN DIVISION: Alhambra, California
EASTERN DIVISION: Howell, Michigan
DISTRIBUTORS IN ALL PRINCIPAL CITIES

*Trademark Registered

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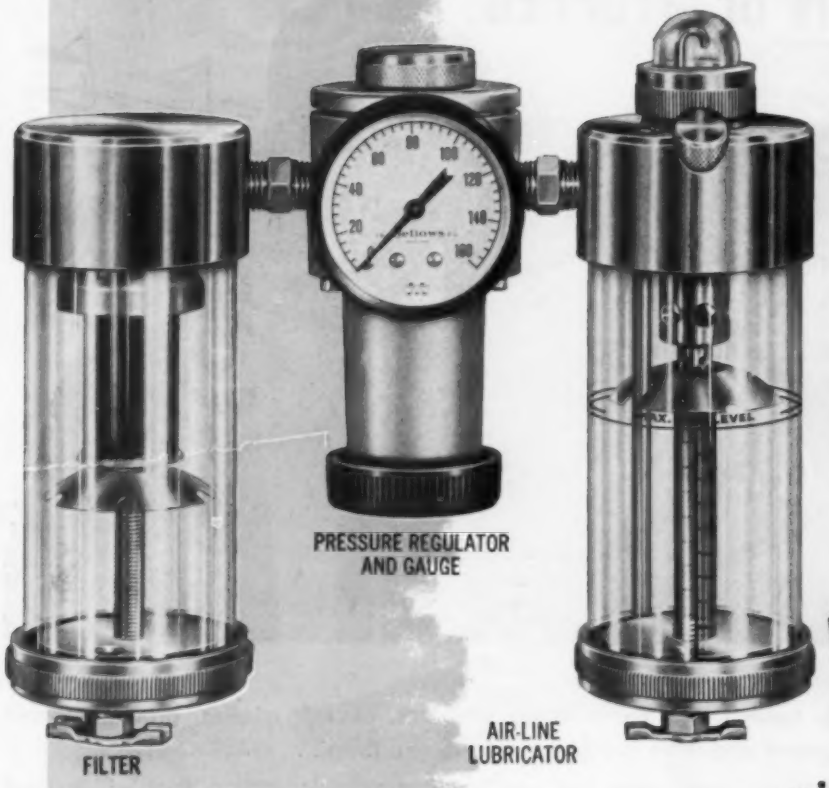
AIR-POWERED EQUIPMENT



PERFORMS MORE EFFICIENTLY

COSTS LESS TO MAINTAIN

GIVES LONGER SERVICE LIFE

with a

Bellows LUBRI-AIR® CONTROL UNIT

HERE'S WHY: Once adjusted to the requirements of a particular air system, the Bellows Lubri-Air Control Unit automatically filters harmful dirt and moisture out of the air stream (40 micron filter element standard; 5, 10 and 20 micron units available) . . . automatically regulates air pressure by compensating for fluctuations in air supply and variation in cfm requirements of pneumatic equipment . . . automatically lubricates air-operated equipment by providing the correct amount of misted oil to the air stream. Bellows Lubri-Air Control Units are available in ¼", ⅜", ½", ¾" and 1" sizes.

Free Bulletin LA-15 gives complete information. Write for your copy today. Address Dept. AH-260. The Bellows Co., Akron 9, Ohio.

OTHER INDUSTRIAL DIVISIONS OF IBEC: Sinclair-Collins Valve Co., Valvair, Akron, O., V. D. Anderson Co., Cleveland, Ohio.

The Bellows Co.

DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)

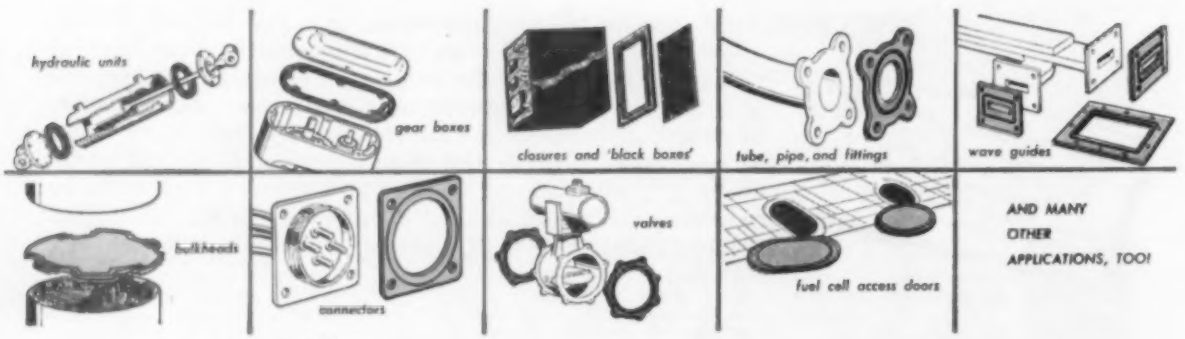
AKRON 9, OHIO

675-C

Safe, sure sealing is vital in today's high performance machines, aircraft missiles, ground support equipment and processing equipment and *there* is a better way to seal them . . . GASK-O-SEALS.

The Gask-O-Seals shown here are static seals that can actually provide sealing that will *exceed* hermetic top specifications. Yet, they are mechanical, can be removed, and reused. *Controlled confinement* of the rubber makes them superior to other seals.

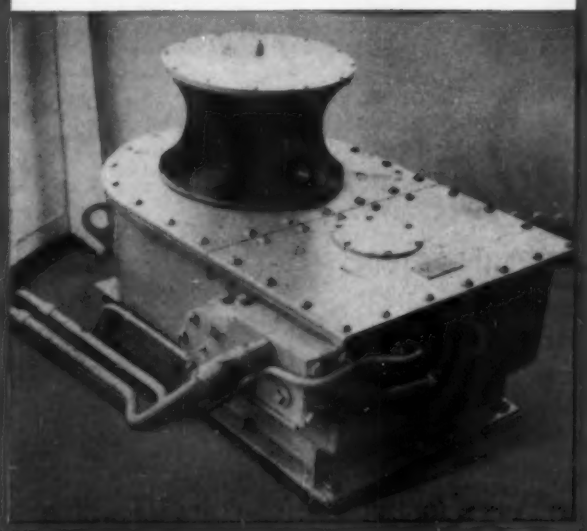
The "typical" applications shown are just a few of the ways Gask-O-Seals are being used. Practical, *truly* economical, no-leakage sealing. If you want to *seal* for *sure*, find out about Gask-O-Seals. Just drop us a line or use the reader service card.



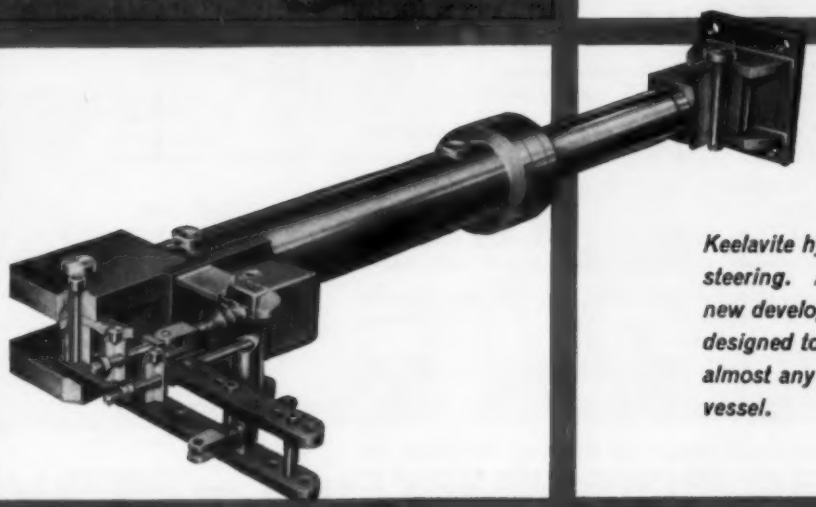
Parker SEAL COMPANY

CULVER CITY, CALIFORNIA and CLEVELAND, OHIO

A DIVISION OF PARKER-HANNIFIN CORPORATION



Keelavite, manufacturers of the widest range of hydraulic power and control equipment are fully experienced in the design, manufacture, installation and maintenance of complete hydraulic systems for the marine industry.



Keelavite hydraulic steering. An entirely new development designed to fit into almost any small vessel.

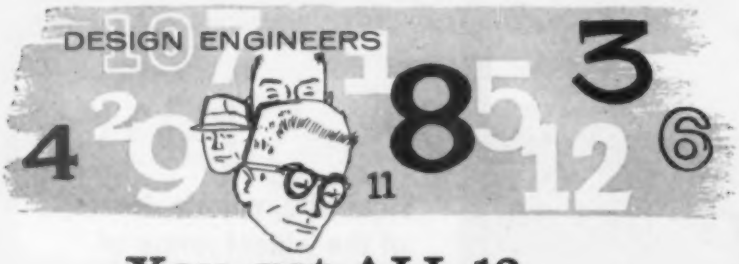
KEELAVITE
Hydraulics

THE RECOGNISED AUTHORITY

Keelavite are ***solely*** engaged in the hydraulics industry

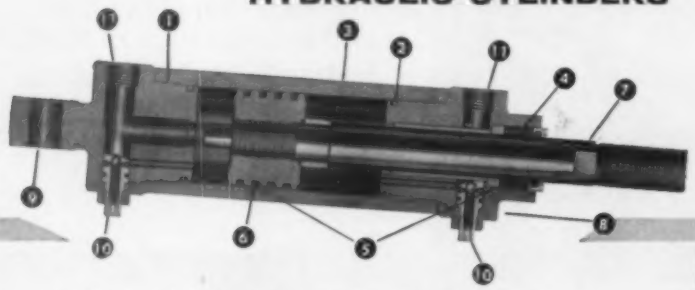
KEELAVITE HYDRAULICS LTD
ALLESLEY, COVENTRY, ENGLAND
Telephone: Meriden 441

Circle **72** on Time-Saver Card



You get ALL 12 only with *Pathon*

HYDRAULIC CYLINDERS



1. Heads retained with a single screw thread for maximum strength, rigidity and minimum size.
2. O-ring head seal in close fitting pilot. Long Pilot maintains concentricity.
3. Heavy wall seamless steel tubing for strength *allows generation of precision bores.*
4. Multi-lip packing for longer life — *externally replaceable.* Rod bearing inboard to packing where it gets *lubrication.*
5. Relatively long span between piston and rod support *resists side loads with reduced unit bearing force.* This eliminates need for "stop tubes" even on long stroke cylinders.
6. Either standard ring type or U-cup type piston available. Both may be *readily installed without special tools* or collapsing devices.
7. Hard chrome-plated piston rod standard. Hardened and chrome-plated alloy steel rods, ground after *hardening for straightness,* optional.
8. Minimum mounting area required on all end mounted units.
9. Integral mounting pads for *rigidity* and permanence. No welding, no brackets.
10. Cushion adjustment requires only 180° turn from full open to full closed. *Makes setting cushions easy.* Equipped with locking nut. *No change of position after setting.*
11. Ports may be located in *any position* relative to each other.
12. No *tie-rods* to *stretch,* or tie-rod *nuts* to *coin* into the *heads* under heavy loads.

Pathon Hydraulic Cylinders are available in nine mounting types, thirteen bore sizes—1¼" through 14", and three Series—for 1,000, 2,000, 3,000.

WRITE FOR BULLETIN 22A P.S.I.

Pathon

MANUFACTURING COMPANY

3823 PACIFIC AVE., CINCINNATI 12, OHIO

FLUID OPERATED AND CONTROL EQUIPMENT

Circle **92** on Time-Saver Card

FUTURE EVENTS

March 6-9

ASME GAS TURBINE POWER & HYDRAULIC CONFERENCE
Rice Hotel
Houston, Texas

March 14-15

ASME LUBRICATION SYMPOSIUM
Engineering Societies Building
New York, N. Y.

April 18-19

3RD ANNUAL CONFERENCE ON AUTOMATIC TECHNIQUES
Sponsored by ASME, IRE, and AIEE
Cleveland-Sheraton Hotel
Cleveland, Ohio

April 21-22

ASME-SAM MANAGEMENT CONFERENCE
Statler-Hilton Hotel
New York, N. Y.

April 21-28

ASTE TOOL SHOW & ANNUAL CONVENTION
Detroit, Mich.

April 25-26

ASME MAINTENANCE & PLANT ENGINEERING CONFERENCE
Chase-Park Plaza
St. Louis, Mo.

April 25-29

1ST INTERNATIONAL COMPRESSED AIR & HYDRAULICS EXHIBITION
Empire Hall
London, England
concurrent with the 2nd European Fluid Power Conference

May 9-11

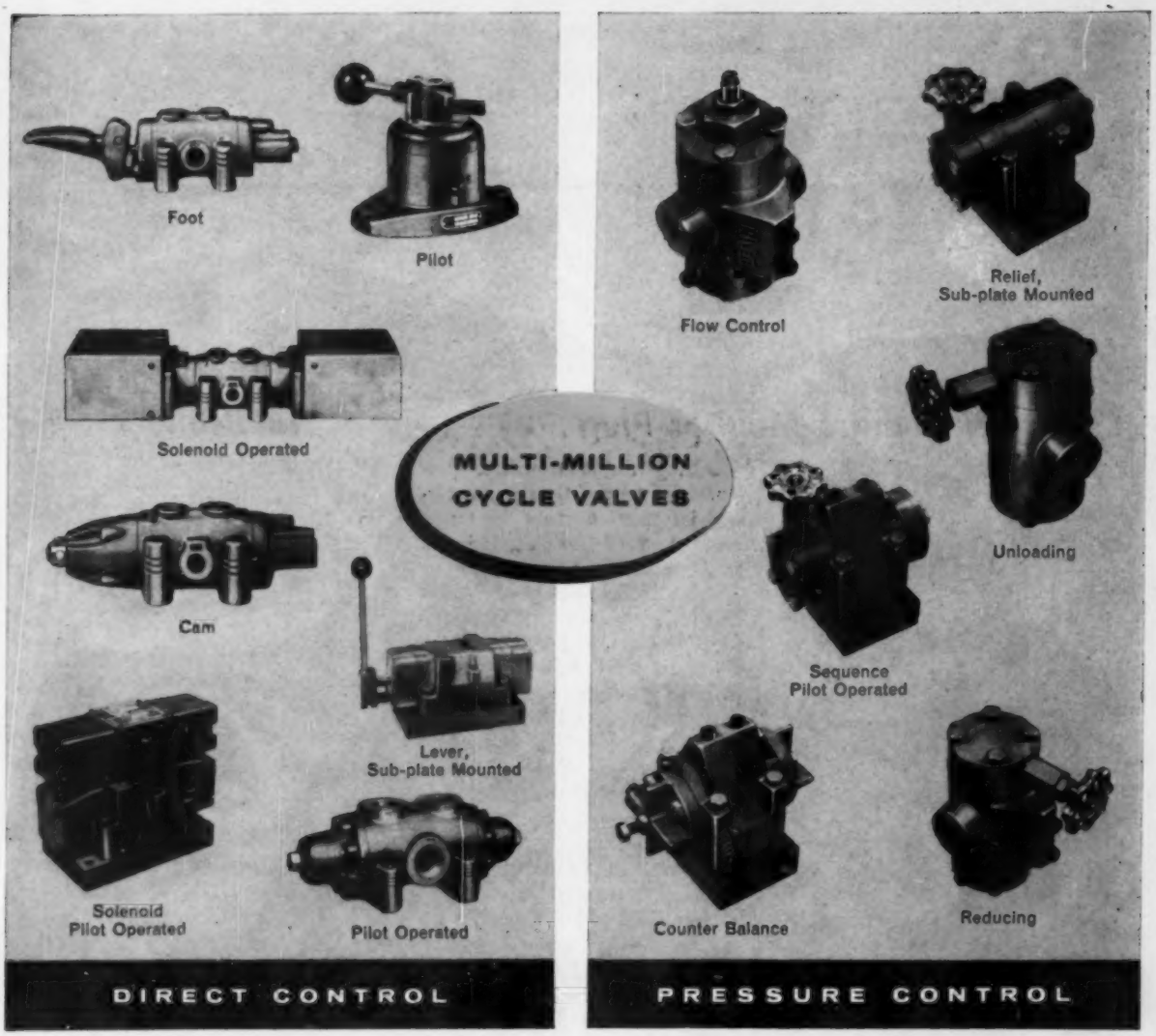
SPRING MEETING, NATIONAL FLUID POWER ASSOCIATION
Grand Hotel
Pt. Clear, Alabama

May 11-14

MEETING, FLUID CONTROLS INSTITUTE, INC.
The Greenbrier
White Sulphur Springs, W. Va.

May 23-26

DESIGN ENGINEERNG SHOW
Coliseum
New York, N. Y.



RIVETT... *is the one source for the correct valve, to control all or part of any hydraulic circuit!*

Whatever your requirements, you can find the right valve at Rivett. Save time, money, inventory and maintenance with these most advanced designs. Greater flow capacity; minimum pressure drop; positive damping and operating stability. From single basic assembly of functional valve any one of six functions may be obtained. Over 400 standard models—sub-plate and pipe mounted; direct control and functional. Pressures 1500 and 3000 P.S.I. All actions, all piston designs, all operations. Sizes ¼" to 2". J.I.C. standards.

RIVETT LATHE & GRINDER, INC.
Dept. AH 2, Brighton 35, Boston, Mass.

The Better You Know Hydraulics—
The Better You Like

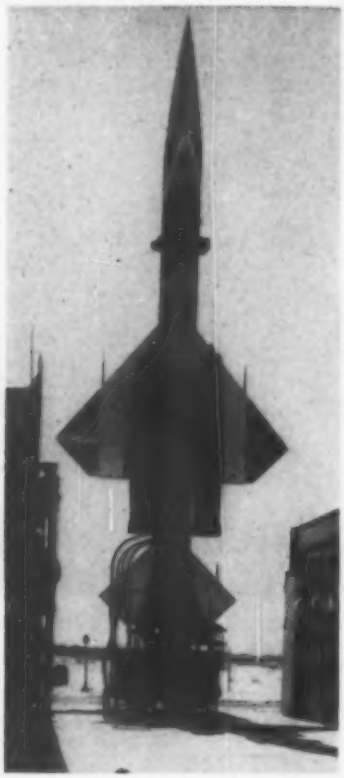
Cat.'s 204, 210, 230 and 261 contain 68 pages describing all valve models, sizes and types with complete working drawings, specifications, performance, ratings, cut-away views. Get free copies today.

RIVETT
HYDRAULIC VALVES

BRIEFS

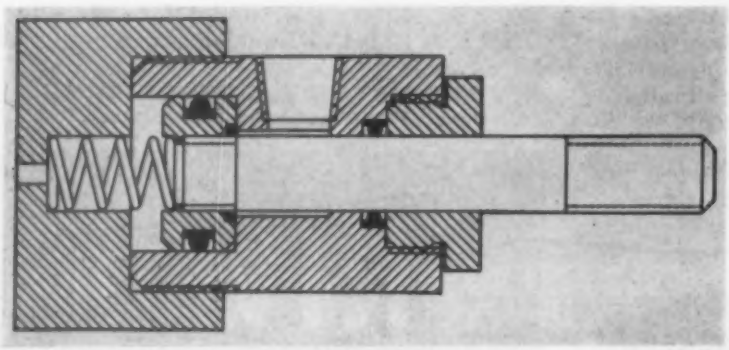
about fluid power

Hydraulic Actuator Casts Off Bomarc Monitor Plug



During the automatic, pre-launch warmup of the Bomarc missile, information about the target location, speed and altitude is fed to the missile through a monitor plug. This monitor plug mounts in a frame attached to the supporting boom that erects the missile. Information is fed through the monitor plug as the launcher moves the missile from horizontal to a vertical position. A solenoid valve, energized when the missile reaches its upright position, directs fluid to the monitor plug, disconnect cylinder.

• **Launching action**—A hydraulic pump keeps 12 accumulators charged to 3000 psi. At the signal to launch, the accumulators actuate roof and door opening cylinders, missile erecting cylinders, and clamps which hold the missile to the base. When the missile is fully erected, a solenoid valve directs fluid to retract two nose clamps. The same hydraulic line that actuates the nose clamps, also supplies fluid to disconnect the monitor plug. ▼▼▼



MONITOR PLUG, DISCONNECT CYLINDER uses T-ring seals for piston and rod. The 1-inch dia. position has a total travel of only $\frac{7}{8}$ inch. *Courtesy Airmatic Valve Co.*

Propeller Pitch Is Hydraulically Controlled

The entire hydraulic system for controlling pitch of four propeller blades on an aerial platform is in the reservoir under each of the four propellers. No lines or fittings are used in the system. Check valves, relief valves, pumps, etc., are all plug-in type. Two

pumps, piped in parallel, assure fluid to the actuator at all times.

The two pumps are ported to a manifold through a check valve. From the manifold, the fluid passes through a servo control valve to the prop blade actuators. The hydraulic fluid also serves as a lubricant for the propeller gear box.

The system was developed by Sargent Engineering Corp. for Curtiss-Wright. ▼▼▼

Tandem Pump Powers Huge Scraper

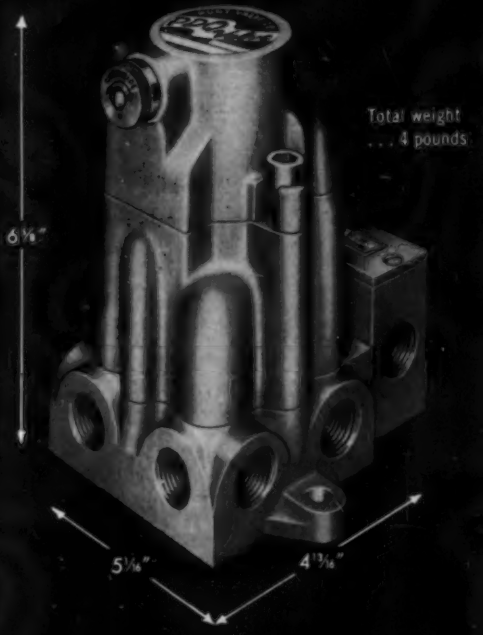
Double-acting, bowl-lift cylinders give tremendous force at the cutting edge of this 30 cu. yd. scraper. Hydraulic power is from

Continued on page 30

Circle 63 →

THE HUNT PDQ

has Faster Response Time and Greater Capacity than Air Valves – *4 Times Its Weight and Twice Its Size!*



Total weight . . . 4 pounds

You asked for a light, compact valve

Here is a full 1/2" air valve at **4 pounds.** It will flow 335 c.f.m. with 100 p.s.i.g. initial pressure to atmosphere. It measures 6-1/2" high by 5-1/16" wide by 4-13/16" deep.

You asked for speed and capacity

Here is what the Hunt PDQ is capable of. Response time to fill a 140 cubic inch vessel to 90 p.s.i.g. with an initial pressure source of 100 p.s.i.g. is .113 seconds. (6.8 electrical cycles.) To exhaust the same vessel from 90 to 10 p.s.i.g. is .195 seconds. (11.7 electrical cycles.)

The short-stroke pilot actuates a compact, full-orifice poppet-spindle amazingly fast . . . renders traditional air valves obsolete.

The Hunt 1/2" PDQ air valve is designed to do the things you've wanted a valve to do since the advent of automation. Write us today.

N. C. Hunt

N. C. HUNT, PRESIDENT

HUNT VALVE COMPANY · SALEM, OHIO, U. S. A.

- ☑ Accessibility
- ☑ Simplicity
- ☑ Speed and Capacity
- ☐ Price and Quality

The Hunt PDQ valve tops them all in every class.

Next month . . . the PRICE and QUALITY story.

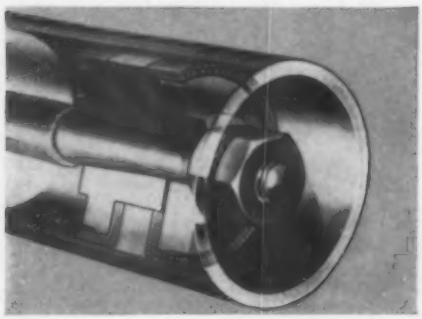
HUNT HVC ***Quick-As-Wink*** AIR & HYDRAULIC CONTROL VALVES

PUMCUPS

outlast ordinary packings

3 TO 1

- *in hydraulic and pneumatic mechanisms*
- *in reciprocating pumps*



With Darcova Pumcups...regardless of wear, pressure keeps Pumcups hugging cylinder wall.

Operating costs go down and efficiency goes up when Darcova Pumcups go in! Here's why:

- **Pumcups outlast other packings at least 3 to 1, based on actual reports from users**
- **Fluid slippage is virtually eliminated, because Pumcups operate at full efficiency throughout their entire life**
- **Maintenance costs are reduced, because you have fewer replacements, less downtime.**

Available in three textures—hard, medium and soft. Also in regular or 100% nylon composition. Size ranges from ¾" to 20". For *all* the facts on Darcova Pumcups, write for Bulletin 5903.

DARLING VALVE & MANUFACTURING CO.

Williamsport 15, Pa.

DARCOVA — THE ORIGINAL COMPOSITION CUP

TRADE MARK PUMCUPS

Circle 38 on Time-Saver Card

BRIEFS

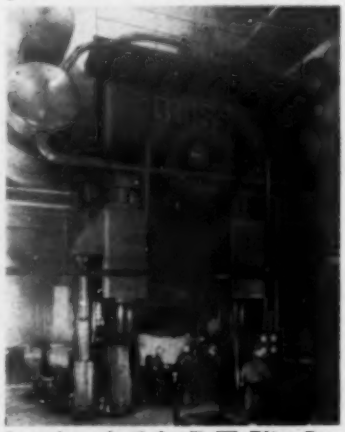
a tandem pump, gear-driven from the rear engine crankshaft. The double-acting steering cylinders and multiplier links give good maneuverability. One-sixth turn of the steering wheel turns the scraper 90 degrees.

Forced ejection is done with twin, telescoping hydraulic cylinders. Cylinders push the center of the ejection for more effective use of power.

Made by Allis-Chalmers, the scraper has large capacity air brakes controlled by a foot pedal. Automatic safety brake valves on both tractor and scraper assure that braking power is available in an emergency. ▼▼▼

Water Hydraulic Press is Automatic

The world's first water hydraulic presses with automatic controls



have been built by E. W. Bliss Co., Erie, Pa. They have pressure ratings to 8000 tons and are used for forging and impact extrusion of aluminum, titanium, and magnesium.

The automatc controls permit exact control of pressure and the

Continued on page 32

Cracking tough heat exchanger problems is what we do best

For more than 40 years, American-Standard* Industrial Division engineers have specialized in designing and making heat exchange equipment for virtually all conditions and applications. Drawing upon this vast experience, American-Standard Industrial Division can base recommendations upon precedents of proved success. And, in many instances, our comprehensive standardization paves the way for savings in cost and time. Get the full story on American-Standard heat exchangers. Send for Bulletin 0.4A9 today. American-Standard Industrial Division, Detroit 32, Michigan.

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INDUSTRIAL DIVISION
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all STEEL

New Fulflo all-steel, piston type, oil relief hydraulic by-pass valves combine proven features with the advantages of all-steel construction in flange models from 1" to 2".

FULFLO

ALL-STEEL, ALL-BRASS OR OTHER COMBINATIONS FOR POSITIVE AUTOMATIC PRESSURE CONTROL YOU CAN DEPEND UPON AT ALL TIMES

all BRASS

Fulflo Valves feature shear-closing action for quiet, non-chattering operation. They offer greatest safety, matched to job conditions. Priced right for O.E.M. use . . . built right for superior replacement service.

- Standard and flanged models
- Just 6 springs for pressures to 500#
- Steel, cast iron or brass bodies
- Brass, steel or stainless pistons
- Pipe sizes to 3"
- Specials to your requirements

FREE, completely NEW CATALOG . . . just off the press!

THE FULFLO SPECIALTIES CO., INC.
415 Fancy Ave.—Blanchester, Ohio

Circle 51 on Time-Saver Card

BRIEFS

rate at which it is applied. The press repeats identical stroke cycles on every work piece. Water to power the presses is supplied at 4500 psi. ▼▼▼

New Books

Oil Hydraulic Power and Its Industrial Applications *by Walter Ernst, Second Edition, 466 pp, $12.50, McGraw-Hill Book Co.*

How oil hydraulic power is generated, transmitted, controlled, and applied in industry is presented in this revised edition. It covers the hydraulic field from basic fluid mechanics, through component and circuit design, to the latest commercial equipment.

Each stage of the hydraulic system is discussed, including the generation of oil hydraulic power by all types of rotary pumps; its use in rotary and reciprocating motors; its control by suitable valves; and its transmission through piping, tubing, and fittings. A number of hydraulically actuated machines, machine tools,

TWO DOUBLE-ACTING HYDRAULIC CYLINDERS tip the hopper on this 3-ton bulk material dumper. It has two separate power units. One drives the hydraulic power pack for the dumping operation and the other drives the unit along the tracks. A manual 4-way valve gives the operator accurate control of the dumping. Made by Essex Conveyors, Inc., Newark, N. J.

Continued on page 34

For Air Control Units Circle 60
For Fittings Circle 98

PARKER-HANNIFIN FLUID SYSTEM COMPONENTS

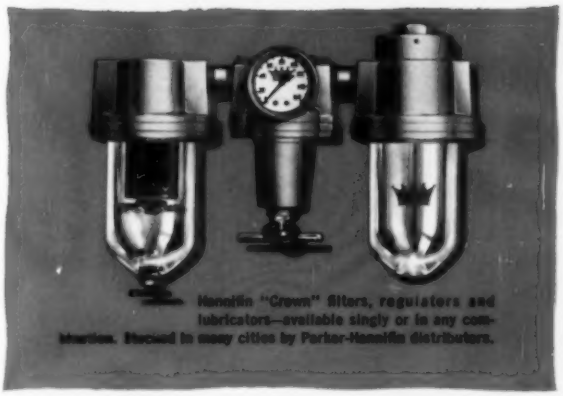
Hannifin air power cylinders, available in a full range of mounting styles, bore sizes from 1½" through 14", strokes to 20 feet. Cylinder bodies bored, then honed satin-smooth . . . for low friction, long packing life.

Hannifin's complete line of air control valves includes electric solenoid-, pressure-, cam-, hand- and foot-actuated valves. Write for our compact new "Valve Finder."

PARKER-HANNIFIN puts air to work without costly leaks

Now... complete pneumatic power systems, engineered for long leak-proof life, are available from your Parker-Hannifin man. Hannifin "Crown" units supply filtered, lubricated air at optimum pressure. Hannifin air valves shift quickly and seal bubble-tight. Hannifin air cylinders and air motors are low-friction, leak-proof. Parker "Push-lok" hose fittings and "Intru-lok" tube fittings provide quick, easy, leak-proof connections. The over-all result is more work from less air!

Our field engineering service helps you design your circuits and select the components. Many items are available locally, from Parker-Hannifin distributor stocks.



Hannifin "Crown" filters, regulators and lubricators—available singly or in any combination. Stocked in many cities by Parker-Hannifin distributors.

The Hannifin air motor combines a high-efficiency, leak-proof power cylinder and its electric control valve with built-in speed controls into one compact package. A single air line connection is needed, reducing installation costs.

A beach-backed hand push joins Parker "Push-lok" hose fittings to Parker hose. No tools required. Won't blow off.

Parker "Intru-lok"® tube fittings are for low and medium pressure lines in copper, aluminum, nylon or polyethylene. You simply insert the tube end and tighten the nut. No-leak, vibration-proof grip.

Parker FITTINGS AND HOSE DIVISION
17325 Euclid Avenue, Cleveland 12, Ohio

HANNIFIN COMPANY
555 S. Wolf Road, Des Plaines, Illinois

DIVISIONS OF PARKER-HANNIFIN CORPORATION

YOUR CHOICE OF 3 *Fulflo Filters*

. . . for Pneumatic Pressures to 125 psi

These rugged, compact Fulflo Filters protect your pneumatic equipment by removing moisture, oil, microscopic rust, dust and scale. Models illustrated are available in three sizes and capacities for operating pressures up to 125 psi: with 3″ patented Honeycomb Filter Tube for maximum flow rate of 65 scfm; 5″ tube for maximum capacity of 110 scfm; and 7″ tube for capacities to 150 scfm.

Sturdy steel shell is domed for extra strength. Metal baffle deflects moisture and oil to sump. Positive seal at top and bottom prevents by-passing.

Other standard Fulflo Filters are available for higher capacities and pressures — even up to 4,000 psi. Write for booklet on complete line to Department AH.

Filter out high costs with CFC Filters

CFC

COMMERCIAL FILTERS CORPORATION

Fulflo Honan-Crane Delpark Michiana

MELROSE 76, MASSACHUSETTS

PLANTS IN MELROSE, MASSACHUSETTS AND LEBANON, INDIANA

BRIEFS

presses, tracer-controlled machines, and others are discussed.

The book contains recent information on petroleum base and synthetic fluids, hydrostatic bearings, closed-loop pump control, directional valve design, and servomechanisms and servo valves. ▼▼▼

Briefs From Europe

• **Compressed Air Regulates Turbines**—Over 600 cfm of air is used in Holland's new power station. It is supplied by three, water-cooled, two-stage, compressors with intercoolers and aftercoolers. The compressors run at contant speed. They unload when they reach maximum pressure, and

Continued on page 39

BRIEF NOTES

SUDDEN PRESSURE SWITCH . . . is the name given to a special pressure switch developed by Cook Electric Co. The switch distinguishes between gradual and rapid pressure changes by using a calibrated orifice. Slowly rising pressure permits equalization of pressure before actuation occurs. A rapid pressure change actuates the switch.

WATERMAN CHANGES NAME . . . To cover its broadening activities in the hydraulic field, Waterman Engineering Co. has changed its name to Waterman Hydraulics Corp. The firm's address and personnel are unchanged.

CRANE HOLDS PACKING SEMINAR . . . The Crane Packing Co. held a seminar titled *How to Get The Most From Your Seal and Packing Dollar*. It was held in Houston, Texas, on Oct. 14 to 16 and is one of a series sponsored by the company for their customers.

DESIGN ENGINEERING SHOW . . . will occupy all four floors of the New York Coliseum May 23 to 26. Over 400 companies will exhibit in the exposition devoted to research and development of new products.

ADVANCED HYDRAULICS . . . a new course at Milwaukee School of Engineering, starts in February. Russ Henke, Chairman of the school's industrial advisory committee on hydraulics announced that the course would consist of seminars with guest lecturers speaking on their special fields. Sessions on servomechanisms, hydro-dynamic devices, and instrumentation will be included.

BUSINESS BRIEFS

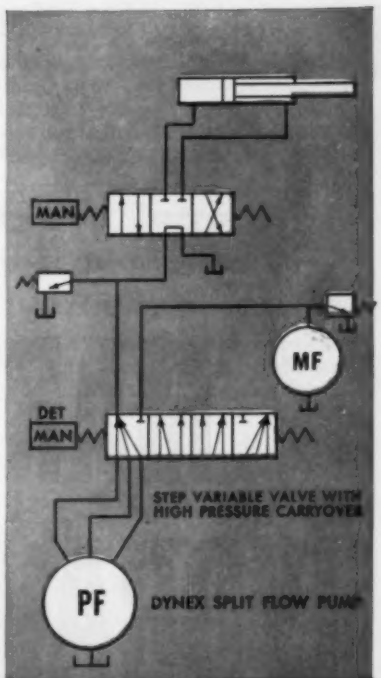
HOWELL ACQUIRES LELAND . . . The Howell Electric Motors Co., Howell, Mich., has acquired the Leland Electric Co., a former division of American Machine & Foundry. The purchase was made to broaden Howell's line and to give them a major position in the electric motor field.

OPENS TWO FOREIGN PLANTS . . . Purolator Products, Inc., Rahway, N. J., has opened a plant in Zug, Switzerland to serve its European markets. A similar company was set up to service markets in Mexico, Central & South America, and the Carribbean.

CORNELIUS GETS FLUID MOTOR CONTRACT . . . A $233,510 contract for hydraulic motors was awarded to the Cornelius Co., Minneapolis, Minn., by Convair, a Division of General Dynamics Corp. A new line of hydraulic pumps is also being introduced by Cornelius.

LOWER TEFLON PRICES . . . Since the introduction of Teflon by E. I. du Pont in 1944 there have been 10 price cuts. They have reduced the price from $18.00 a pound to the present $3.60 a pound.

AMERICAN BRAKE SHOE BUYS SERVOVALVE FIRM . . . Through an exchange of stock, The American Brake Shoe Co. has bought Raymond Atchley, Inc., a prominent manufacturer of electrohydraulic and electropneumatic servocontrols. Atchley will be operated as a wholly-owned subsidiary.



HIGH PRESSURE IS

FLEXIBILITY

Piston pumps in which the flow can be split into two or more separate circuits can allow a single pump to replace two or more pumps and operate each circuit at different pressure levels. New slide valves in which the tank port can withstand full pressure opens up new circuit possibilities. A valving sequence is established whereby the upstream valve has priority, but when the flow is not required at that point, it is available at a remote downstream point at full working pressure. This splitting and combining of flow at will can generate novel and unique circuits.

dynex INC.

A DEVELOPMENT OF BLACKHAWK MFG. CO.

IS HIGH PRESSURE

777 DYNEX DRIVE • PEWAUKEE, WISCONSIN

HYDRAULIC PUMPS • VALVES • MOTORS • CYLINDERS • CIRCUITS

Circle **42** on Time-Saver Card

MARINE HYDRAULIC POWER NEWS

FROM DENISON

Handling sugar cargo faster with DENISON-powered hydraulic elevator

A unique shipboard hydraulic elevator—powered by Denison hydraulic equipment—helps speed cargo handling and cut costs for San Francisco's Bay and River Navigation Company.

CARGO HANDLING VESSEL . . . *M. V. Mokuhana with location of hydraulic loading elevator shown. Elevator openings on both sides of ship are closed by roll-down doors.*

Regardless of tides or dock heights—their M. V. Mokuhana can load or unload its sugar cargo at peak rates of 155 tons an hour. A vessel-load of 600 tons—on pallets in 100-pound sacks—is handled efficiently, rapidly by heavy-duty fork trucks.

In operation—loaded trucks are run onto the elevator-platform which is raised hydraulically to dock level. Result: No inclines . . . fork trucks roll smoothly off the dock and onto the ship ready to position pallets on the cargo deck. The operation is many times faster than overhead loading through hatches.

HYDRAULIC LIFTING POWER . . . *for the cargo elevator is supplied by a single Denison 2000 psi Vane Pump—driven by a diesel engine through gear reducers and clutches.*

SHIPBOARD HYDRAULIC ELEVATOR . . . *powered by Denison hydraulic equipment . . . speeds and cuts cost of cargo handling. Platform quickly raises or lowers fork-trucks to dock level. Sugar cargo is handled hydraulically at peak rates of 155 tons an hour*

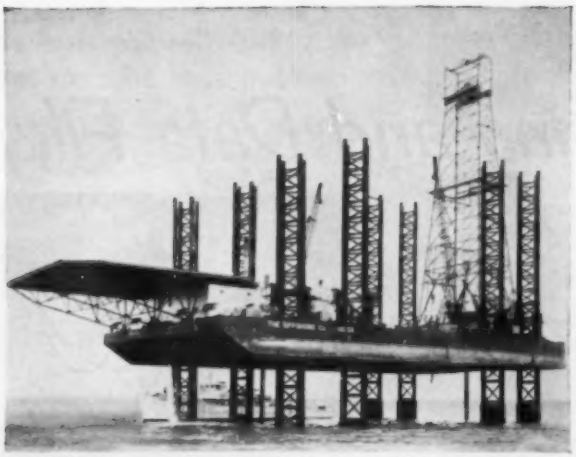
The M. V. Mokuhana is a specially designed, short-run cargo vessel . . . literally "built around" a freight elevator whose hydraulic system was designed by Oakland's Ditzen Engineering and Sales Company.

Powered by a Denison 2000 psi Vane-Type Pump—the 10 by 24-foot elevator platform can be rapidly accelerated to a lift speed of 60 feet-per-minute under a full load of 17 tons. Total elevator lift range is over 15 feet.

After 4 years of constant use under maximum loads, the Denison hydraulic equipment aboard the M. V. Mokuhana has required no maintenance. It's extra proof that dependability and quality of Denison hydraulic equipment pay off.

Lifts 6000 tons out of the sea with DENISON hydraulic pumps

When The Offshore Company faces the problem of raising its 6000-ton DeLong drill barges, they rely on Denison axial piston pumps to deliver the necessary muscle. Rated at 5000 psi continuous duty, four Denison pumps lift the 6000-ton platform at rates up to 15 feet-per-hour . . . with precision



DRILL BARGE . . . *operated off the Gulf Coast by The Offshore Company . . . is raised and lowered hydraulically. 6000-ton rig can be moved at rates up to 15 feet-per-hour.*

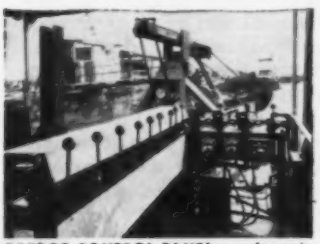
control from one central source.

Utilizing a Series 800, 35 gpm Denison pump at each corner, the hydraulic system, developed by DeLong and built to specifications by Denison, is capable of actuating lifting jack cylinders separately or in concert as needed. The result is close regulation of the massive 6000-ton load through a system of 16 individual hydraulic jacks on 8 caissons or towers.

ACTUATING SYSTEM CONTROLS *for raising and lowering heavy off-shore rigs built by DeLong Corporation, New York. Denison axial piston pumps actuate hydraulic jacking cylinders, separately or in unison.*

Dredge clears Gulf Coast shipping lanes with DENISON hydraulic power

ALL-HYDRAULIC DREDGE . . . *operates in the Mobile Bay area, keeping shipping lanes clear. Hydraulic equipment powers the entire rig's dredging operations.*



DREDGE CONTROL PANEL . . . *shown in close-up. All-hydraulic system easily allows one operator to control both cutter head and discharge pipe action.*

Hard at work up and down the Mobile Bay area—this dredge's job is keeping Gulf shipping lanes clear. The dredging operation is all-hydraulic—and Denison fluid pumps and motors power the system efficiently ...dependably at extremely low cost.

Five Denison Fluid Motors and a 2000 psi Vane Pump raise, lower and swing both the cutter head and discharge pipe. Power source for the hydraulic system is a 200 hp engine.

Built by the Mobile Ship Repair Company of Mobile, Alabama, for the City of Mobile—the dredge's hydraulic system was designed to do rugged dredging jobs with power to spare. And Denison equipment helps do channel clearing jobs quickly . . . efficiently . . . economically for the City of Mobile.

Driving the Point Barrow's main steering gear with DENISON hydraulic power

With its mission to service ice-bound arctic military bases—the new USNS Point Barrow is in for extra-rugged sea duty. And Denison hydraulic equipment aboardship—powering the main steering gear and telemotor transfer system—is helping the Point Barrow accomplish its mission more efficiently and dependably.

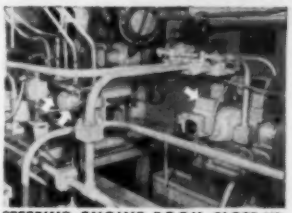
NEW USNS POINT BARROW *(T-AKD-1) ice-strengthened cargo ship dock, built by Maryland Shipbuilding & Drydock Company, is operated by the Military Sea Transportation Service. Its Denison hydraulically powered main steering gear and telemotor transfer system were built by Hyde Windlass Co., Bath, Maine.*

Powering and controlling the main steering gear . . . Denison hydraulic equipment provides a low-cost, reliable and highly efficient pump power package. The unique Point Barrow is a twin-screw, single rudder ship with Denison Axial Piston steering pumps located fore and aft in the steering engine room.

In addition—Denison piston pumps and piston motors are used in the hydraulic telemotor transfer system. Because of the high volumetric efficiency of Denison pumps, accurate steering is more easily controlled through the system.

Denison hydraulic equipment is engineered to deliver dependable, low-cost fluid power for every marine need—steering systems . . . cargo handling equipment . . . winch and windlass drives.

Your nearby Denison Hydraulic Specialist can help you save time and money on your next marine hydraulics problem. Wire or write us for full details!



STEERING ENGINE ROOM CLOSE-UP *shows two 500 Series Denison Axial Piston Motors (arrows at left) serving as "B" end for hydraulic telemotor system. A Series 30 Variable Volume Rotary Servo Control Cross-center Axial Piston Pump (arrow at right) serves as hydraulic power-package for main steering gear.*

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DENISON HydrOILics

HYDRAULIC PRESSES • PUMPS • MOTORS • CONTROLS

DENISON ENGINEERING DIVISION
American Brake Shoe Co.
1166 Dublin Road • Columbus 16, Ohio

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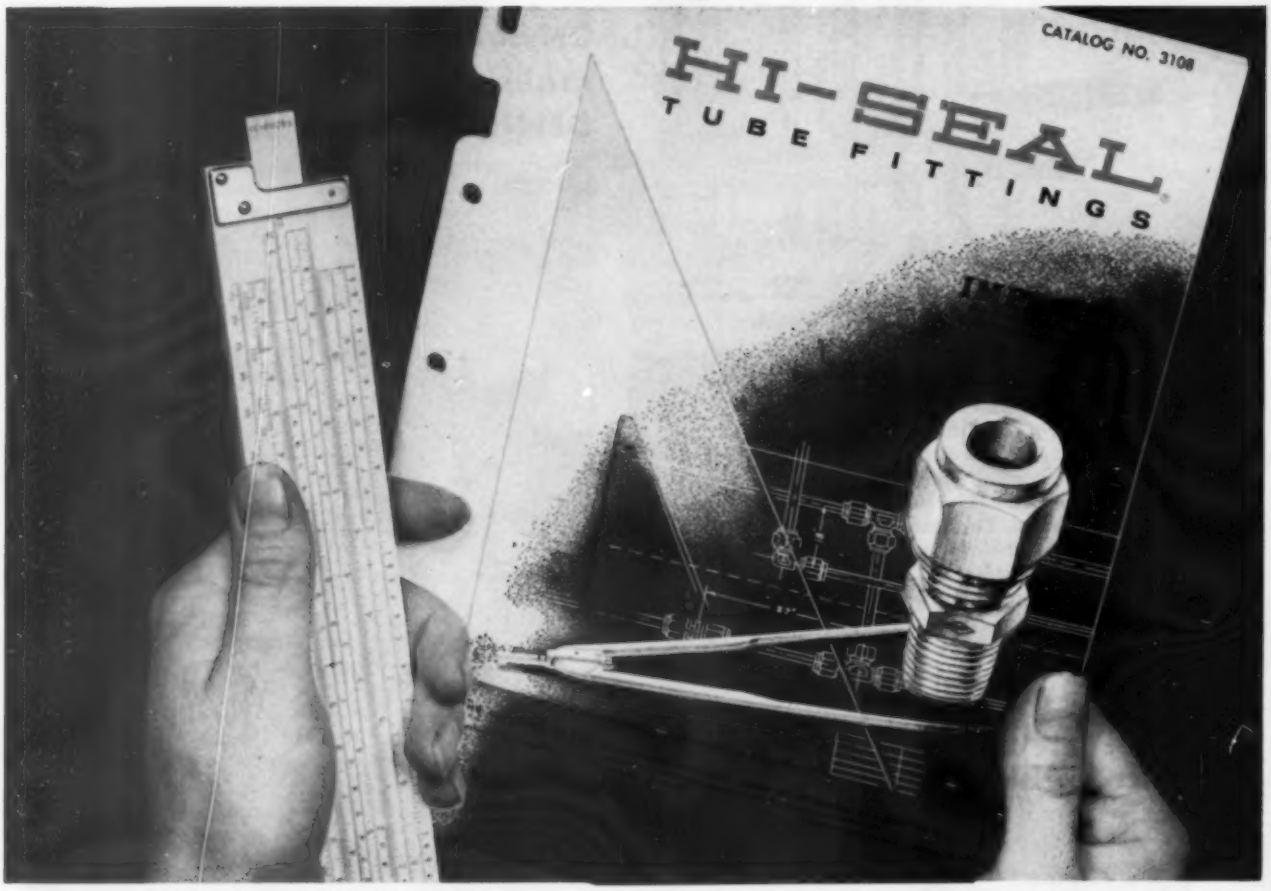


Your slide rule or this New Hi-Seal Tube Fitting Catalog...

YOU'LL WONDER WHICH ONE HELPS YOU MOST!

Just off the press! A working handbook for every man concerned with tubing and fitting circuitry. Published by the company with a habit of leadership.

Leading hydraulic and pneumatic engineers, when asked to study advance proof copies of Imperial's new Hi-Seal Catalog, came back with comments like these: "It's a reference manual" . . . "The kind of material I've had to dig up for myself, until now, from several reference sources" . . . "Make sure I'm on your list for a copy as soon as they are available."

The new Imperial Catalog of Hi-Seal tube fittings contains data, charts, laboratory tests, and formulae on corrosion, vibration, temperature, pressure and vacuum, flow and velocity — vital statistics in hydraulic and pneumatic tubing circuitry design. And it describes the complete line of Imperial Hi-Seal Tube Fittings — *industry's most complete line,* based on a single-design concept, that meets all tubing circuitry requirements. All items in this catalog are stock items and are priced as stock items.

THE IMPERIAL BRASS MANUFACTURING CO.
Dept. AH-20, 6300 West Howard Street
Chicago 48, Illinois

Circle **68** on Time-Saver Card

How Imperial's new Hi-Seal Catalog helps you solve these problems:

SUPER-HIGH PRESSURES. At your fingertips: five pages of recommended maximum working pressures for a variety of tubing materials, from minor to 150% surge with a safety factor of ten, including Braze-Seal Fittings, the first and only make and break joint for extreme pressures and temperatures.

CORROSIVE ATMOSPHERES. Engineering Data: Comprehensive chart rates 140 fluids — from sour gasoline to oxalic acid — and the effect each has on six stainless alloys, brass, copper and aluminum.

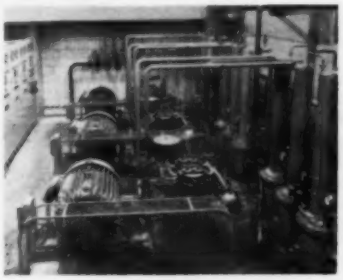
Also covered: formulae for calculating surge pressures, tube bursting pressures, Saybolt viscosity, Reynolds number, Harris formula, and others.

SPACE LIMITATIONS. Pages of facts, diagrams, sample systems, showing how Hi-Seal's unique design concept — throughout the complete line — can produce layouts that are more compact, save space, save time, save tubing.

Get your copy of the new Imperial Hi-Seal Tube Fitting Catalog now. Tell us which type of fitting you are most interested in — we'll send you a free sample.

BRIEFS

start compressing again when the pressure drops 7 psi.



The 115-psi air is used to regulate the steam turbines, operate pneumatic tools, and open and close high windows. ▼▼▼

• **Hydraulic Screw Jacks Raise Hatch Covers**—A new hatch cover made in Europe uses hydraulic screw jacks attached to the hinges to raise and lower. Oil pressure to the hatch covers is controlled from a central station. Pilot check valves compensate for

the weight of the covers and prevent them from falling if a pressure line breaks. The covers can be opened or closed in 45 seconds. ▼▼▼

• **Servos Control Copying, Speed, and Position**—Sperry Gyroscope Co., Ltd., now produces electrohydraulic servo equipment for positional and speed control, and copying.

For positional control, synchros compare the positions of master and load ram. If there's an error, the load synchro sends a signal to the amplifier, and the servo actuates the load ram, eliminating the error. Flow capacities of the servos are from 2½ to 15 gpm; operating pressures, to 3000 psi.

For speed control, a hydraulic motor drives a tacho-generator which gives an output proportional to the speed. The tacho sends a signal to a manual controller. The controller operates the electric motor in the servo valve which controls flow to the hydraulic motor. Thus, the controller biases the tacho signal.

For copying, a cylinder is attached to the machine slide, and the ram's piston rod is anchored to the machine frame. A pick-off "feels" the template and sends signal error to the amplifier. The amplifier actuates the servo valve which adjusts the ram, eliminating the error. ▼▼▼

• **Hydraulic Pump Circulates Blood During Surgery**—Part of a heart-lung machine, a stainless steel pump provides external blood circulation during chest surgery. Calibration of delivery is simple: a helical rotor gives a positive flow, proportional to the speed of rotation. Seven different pump types were tested to find which least damages blood cells. For easy sterilization, the pump quickly dismantles without tools. ▼▼▼

Britain Plans Fluid Power Exposition and Conference

The First International Compressed Air and Hydraulic Exposition will be held at Olympia, London, England from April 25 through April 29, 1960. Manufacturers of fluid power equipment in Britain, the U.S.A., and Europe will exhibit their latest equipment.

The Second European Fluid Power Conference will run concurrently with the exposition. Papers will be presented for discussion by prominent hydraulic and pneumatic engineers from the United Kingdom and Europe.

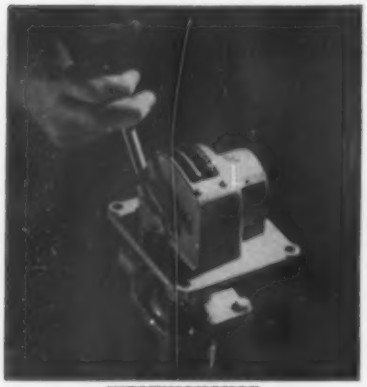
The entire program is sponsored by Compressed Air & Hydraulics magazine. ▼▼▼

Fluid Power Jacks Barge 10" per min.

Fourteen jacks, each with a 500-ton capacity, can raise The Offshore Co.'s rebuilt barge 10" per minute at full load. At 120 tons per jack, the speed is 40" per minute. These rates place the system

Continued on page 40

Typical Control Functions solved by AIR CIRCUITRY



WESTINGHOUSE "H" CONTROLAIR® VALVES

Air control valves are not limited to directional control in Westinghouse Air Brake Company's complete line of Air Circuitry components. Pressure control, in addition to directional control, is obtained with the versatile "H" CONTROLAIR Valves. The position of its operator—lever, pedal, cam or knob—determines the air pressure delivered by the valve. Changing operator positions changes delivery pressure.

Precise pressure graduations may be made in one or two outlets to provide exacting remote control of variable force and positioning applications. Besides those functions illustrated a wide variety of pressure and directional control combinations is available. For details, ask for Catalog D4-65.00.

Applications for "H" CONTROLAIR Valves are limitless. They operate:

Throttles	Rolling Mills	Marine Propulsion Engines
Clutches	Presses	Construction Equipment
Brakes	Shears	Oil Drilling Rigs
Clamps	Conveyors	Production Tools
Gates	Dredges	Cranes and Shovels

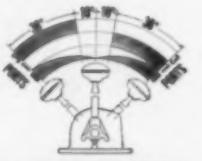
and many other kinds of equipment and machines. In fact, "H" CONTROLAIR Valves are used wherever it is necessary, or preferable, to have instant and convenient control of the flow of air into a pneumatic circuit and of the pressure build up of air in that circuit.

What is AIR CIRCUITRY?

This is the Westinghouse term for application of pneumatic control systems to industrial production operations. Safe, economical, precise AIR CIRCUITRY is now being used to solve the most rigorous and complex control problems in industry. Westinghouse Air Brake has pioneered the application and development of air control for more than 80 years. Today our engineers can design an air circuit which will help you boost production and cut costs in your plant or shop.

1. SINGLE LINE PRESSURE CONTROL—Pressure regulation in a single line is obtained through the H-2 CONTROLAIR Valve. This lever-operated, 3-way, pressure regulating valve increases, decreases or maintains outlet pressure according to its lever position. Several types of lever return or holding functions are available.

2. DIRECTIONAL PRESSURE CONTROL—The HC-2 CONTROLAIR Valve provides pressure graduation to either of two outlets. This lever-operated 4-way, pressure regulating directional valve consists of two 3-way directional valves and a 3-way pressure regulating portion. Lever movement either side of its "Neutral" position selects the outlet to be activated. Further lever movement in the same direction controls the pressure of the air delivered to that line.



3. DIRECTIONAL AND PRESSURE CONTROL—Pressure regulation plus full supply pressure directional control is possible with the HD-2 CONTROLAIR Valve. This lever-operated valve consists of two 3-way directional valves and a 3-way pressure regulating position. Each unit has its own outlet. Lever movement either side of "Neutral" provides full inlet pressure to a chosen outlet plus graduated pressure to a third outlet.

4. TWO RATE PRESSURE CONTROL—The first 60° of lever movement from the "Off" position provides an increase in delivery pressure from 0 to 40% of maximum value in the H-2-E type CONTROLAIR Valve. The remaining 32° of lever movement increases from 40% to its maximum value. Used in applications that require closer pressure adjustment at the low end of the delivery pressure range than at the high pressure end of the range.

See the Yellow Pages under Cylinders for the Name of Your Local Distributor

WESTINGHOUSE AIR BRAKE COMPANY

INDUSTRIAL PRODUCTS DIVISION, WILMERDING, PENNSYLVANIA

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BRIEFS

with the world's fastest. The jacks are driven by four 130-hp, 3000 psi power units, designed by Hydro-Air Engineering, Inc., St. Louis. The company also designed

the controls, including the central control console. The barge legs descend to depths of 100 feet until they take up the barge load. ▼▼▼

No Sudden Impact With Hydraulic Cutting Machine

A smooth hydraulic motion forces die through material onto

the conductive cutting surface of United Shoe Machinery Corp.'s Hytronic cutting machine. Completing an electronic circuit through the die, this contact reverses the swinging beam. Although its maximum force is

Continued on page 42

HYDRECO® Presents • • • •

a New Concept in Dump Truck Body Control

VT Series Control Valve

Custom Designed for Dump Trucks—Made in Volume for Maximum Economy for YOU!

DESIGN—

Custom designed for Dump Trucks 10 Ton to 50 Ton Capacity.

VT Valves automatically return to detented float position to speed dumping cycle and protect cylinders from damage on rough terrain.

•

Low pressure drop through the valve body and control plunger insures fast lowering and a cool system.

•

Patented check valve in the hollow plunger eliminates reverse flow while changing operating positions.

•

Small envelope size . . . large hydraulic capacity . . . one size for all large dump trucks.

•

Write:

Get full particulars on this new HYDRECO Control Valve today . . .

HYDRECO DIVISION
THE NEW YORK AIR BRAKE COMPANY
9004-2 EAST MICHIGAN • KALAMAZOO • MICH.

ANNOUNCING

SHATTER-GUARD

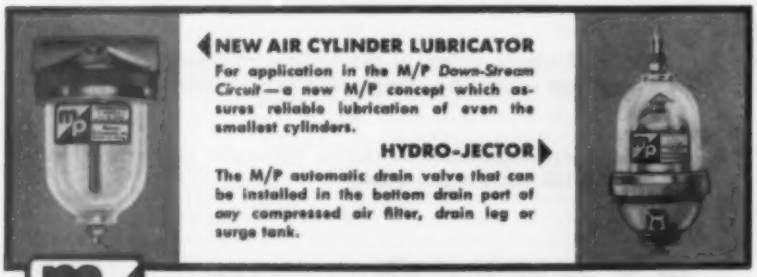
A safety feature now standard on M/P Filters and Lubricators

- Eliminates the "burst" hazard
- Contains all fragments and parts including drain cock when burst occurs
- Resists damage by impact
- Retains visibility advantage

Any transparent filter or lubricator bowl used in a compressed air system may be weakened by *impact, heat* or *chemical attack*. The eventual burst frequently scatters parts and fragments violently.

To eliminate this hazard M/P now supplies the *Shatter-Guard* as a standard part of every *Visi-Bowl* unit. *Only M/P transparent bowls are as safe as metal bowls.*

A brochure outlining bowl-breakage causes and describing M/P Field Conversion Kits is available. Consult your local representative or M/P for complete information.



NEW AIR CYLINDER LUBRICATOR

For application in the M/P Down-Stream Circuit—a new M/P concept which assures reliable lubrication of even the smallest cylinders.

HYDRO-JECTOR

The M/P automatic drain valve that can be installed in the bottom drain port of any compressed air filter, drain leg or surge tank.

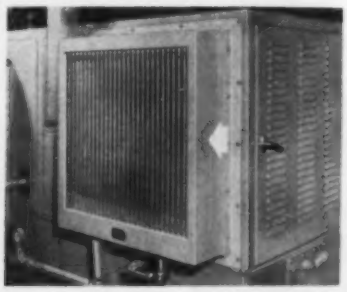
MASTER PNEUMATIC, INC.

20430 SHERWOOD • DETROIT 34, MICHIGAN • Phone: TWinbrook 3-7070

Circle **80** on Time-Saver Card

BRIEFS

32,000 lb., the machine uses only enough force to cut the material cleanly. Maximum stroke is 2¼". There is no need to preset the clearance between beam and die. ▼▼▼

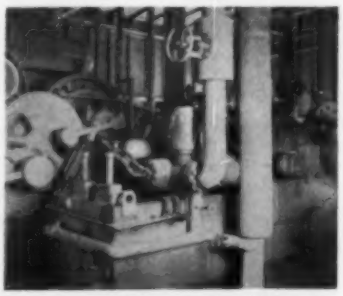


Courtesy Young Radiator Co.

THIS AIR-TO-OIL COOLER holds maximum hydraulic oil temperature at 130 degrees on Kearney & Trecker's hydraulically operated, tape controlled, multi-purpose machine. Turbulators in the high pressure core break hot oil flow. This gives maximum heat transfer with minimum pressure drop.

Steam Turbine Drives Hydraulic Pump

Aboard the Navy's floating, pile-driver barge, electric power is scarce, so they drive the hydraulic pump with a geared down



Courtesy The Oilgear Co.

steam turbine. The pump delivers fluid to a double acting cylinder through a 4-way valve and a brake-hold valve. The cylinder positions the pile-driving boom so that piles can be driven straight down or at an angle. ▼▼▼

Continued on page 44

DOWTY
INDUSTRIAL *Hydraulics*

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Precision built, cartridge construction, pressure balanced, in the ranges :—

Gear Pumps :- Flows at 1500 r.p.m. from ·50 to 50 Imp g.p.m.

Gear Motors :- Reversible. Outputs up to 25 H.P. Speed range 300-3000 r.p.m.

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All prize papers will be published in APPLIED HYDRAULICS & PNEUMATICS Magazine. Papers receiving honorable mention awards will also be published during 1961 and paid for at regular rates.

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Committee of Judges:

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R. K. Sedgwick, Assistant Chief Engineer, Servo Machine Tool Div., Kearney & Trecker Corp.

W. E. Mayhew, Staff Engineer, Advanced Fluid Systems Research & Development, Republic Aviation

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BRIEFS

High Accuracy Needs Close Temperature Control

Even the slight error caused by temperature variation in hydraulic fluid can't be tolerated when you're grinding to a tolerance of .0001 in. The cooling system on this Ex-Cell-O tape-controlled grinder keeps the fluid temperature at a constant 72 degrees.

Wheel dressing may be manual or tape controlled. The dresser

is mounted behind the grinding wheel and advanced toward the wheel hydraulically or manually in increments ranging from .0022 to .0002 in.

To dress the wheel, the spindle is brought to its center position and hydraulically clamped. The dresser slide then feeds forward the amount to be dressed. After dressing, the main slide automatically advances to compensate for the reduced wheel size. The grinding cycle resumes when the tape calls for it. ▼▼▼

On Heart Sunday February 28

GIVE® to *Fight* Heart Disease

All Pressure Regulators are not alike

Norgren

Baffle and Siphon Tube Construction

provides more uniform regulated pressure as flow demand changes

In the ideal pressure regulator there would be no change in the regulated pressure no matter how wide the variations in the flow rate.

Norgren Pressure Regulators approach this ideal by providing a baffle and siphon tube feature. This increases the sensitivity of the valve to changes in the flow rate through the regulator and provides better performance and a more uniform regulated pressure over a wide range of flow rates.

The baffle protects the diaphragm from pressure shock and abrasive action. This gives you longer regulator life, more dependable operation and minimum maintenance.

For complete information on all your regulator needs, ⅛" to 2", call your nearby Norgren Representative listed in your telephone directory- or WRITE FACTORY FOR DESCRIPTIVE LITERATURE.

Norgren Pressure Regulators give you these important features:

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- Large Nylon-reinforced Buna N Synthetic Rubber Diaphragm—long service life
- Baffle Plate and Siphon Tube—increased accuracy
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- Easy servicing while still on air line
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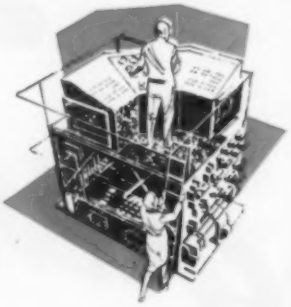
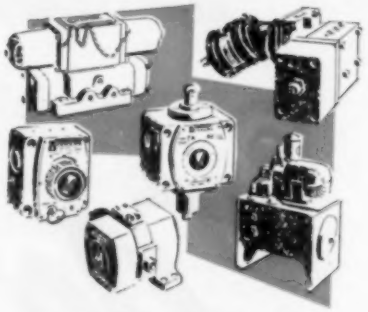
Advanced Design—More than 800 engineers and technicians plus unequalled research and development facilities devoted to every phase of hydraulics assure that Vickers will continue to provide the finest in products and systems.

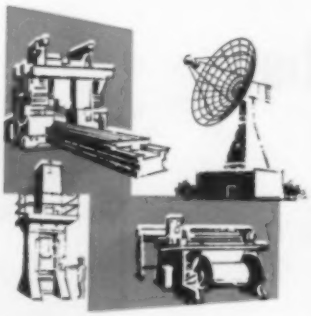


Unified Systems Responsibility—When the job calls for a more complex installation, you don't have to develop your own system by "shopping around". Vickers provides custom engineered, ready-to-go systems that invariably save you money in the long run.

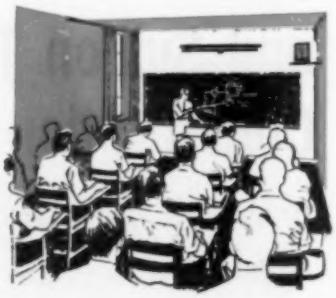


Most Complete Line—Because Vickers designs and builds the broadest line of top quality hydraulic components available anywhere you are assured of getting just what your installation requires. You don't have to compromise performance in any way.

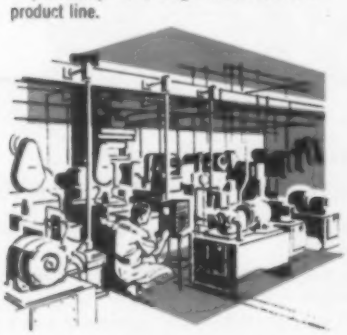
"Single Line" Application Engineering—You can rely on top quality field assistance in planning any hydraulic installation because your Vickers sales engineer is just that—a highly qualified engineer with responsibility for a single manufacturer's product line.



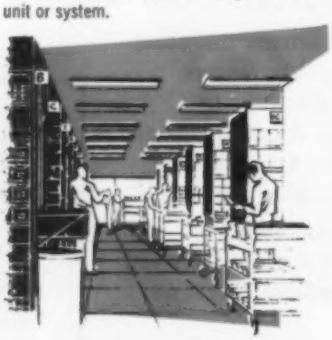
Hydraulic Experience without Equal—Nearly 40 years of experience in developing and building hydraulic equipment that has won a worldwide reputation for being advanced in design and reliable in performance stands behind every Vickers unit or system.



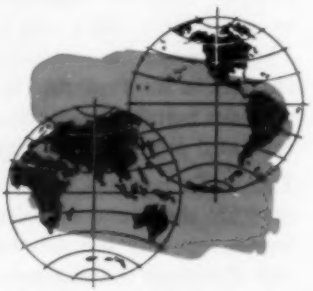
Customer Training—Your engineers, technicians and maintenance men benefit from attendance at Vickers' hydraulic school or Vickers-sponsored hydraulic conferences. These activities plus technical publications help keep industry posted on the newest fluid power ideas.



Unmatched Field Service—No matter where your equipment goes to work a skilled Vickers service man is close at hand to insure that it always performs as specified. Because he's responsible for a single manufacturer's product line, he's up-to-date on latest designs and techniques.



Regional Repair and Parts Stocking—Not only do Vickers units outperform and outlast ordinary designs but you have less downtime for maintenance too. When service is needed, regional service centers provide units tested to factory specifications assuring peak operating efficiency.



International Manufacturing Sales and Service—No matter where Vickers parts are made throughout the free world, they are completely interchangeable. Thus, you gain added freedom in design and manufacture of your product, particularly if it is intended for export sale.

Machine builders and users choose VICKERS® hydraulic pumps and valves by wide margin

"Machinery Magazine" study shows Vickers leads next brand by 4.4 to 1 in pumps, 6.4 to 1 in valves

Once again users and builders of machinery have shown an overwhelming preference for the quality and performance of Vickers hydraulic pumps and valves. In the recently completed "Machinery Magazine Brand Preference Study" Vickers pumps and valves not only attained considerably higher weighted scores than the runners up but enjoyed even wider margins in the "first choice" categories (see tabulation below).

Close cooperation with its customers—large and small—has characterized Vickers operations over the years and is reflected in this "vote of confidence" from the field. The end result is that buyers of machinery have come to accept Vickers-equipped machines as offering something extra in reliability and productivity.

When you specify Vickers hydraulic components, you get the finest hydraulic equipment of the most advanced design and more besides. Some of these extras are described briefly on the facing page. For more details on any of these or the complete line of hydraulic components or systems contact your nearby Vickers application engineer or write for the new Vickers catalog 5001.

HYDRAULIC PUMPS

	First Choice	Second Choice	Third Choice	Weighted Total %
Vickers	186	56	14	49.2
Company B	31	29	5	11.2
Company C	25	23	12	9.6
Company D	20	26	11	8.9

22 other companies accounted for the remaining 21.1% of the weighted total.

HYDRAULIC VALVES

	First Choice	Second Choice	Third Choice	Weighted Total %
Vickers	147	32	7	47.1
Company B	18	9	9	7.4
Company C	13	16	—	6.5
Company D	8	14	5	5.2

24 other companies accounted for the remaining 33.8% of the weighted total.

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DIVISION OF SPERRY RAND CORPORATION

Machinery Hydraulics Division

ADMINISTRATIVE and ENGINEERING CENTER

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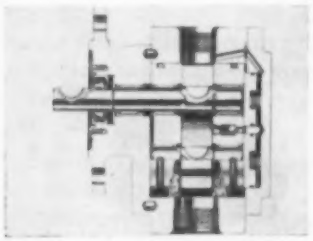
NEW PRODUCTS

Components, tools and equipment for fluid power systems. For more information fill in and mail post card bound in this issue.

GEAR PUMPS
. . . are pressure-loaded

Features: Viscosity and load variations don't affect flow's uniformity. One-piece blocks contain needle bearings. Bearings don't misalign



under loads. Hydraulically-actuated pistons push floating bearing block against gear faces. Block takes up wear, maintains zero end clearance. Actuating pistons are offset toward pressure side and are approximately opposite center of internal pressure. This insures uniform wear over wear plate.

Specifications: Capacities: standard, 5, 10, 15, 30 gpm; special, 100 gpm. Pressure: 3000 psi, constant; 4500 psi, intermittent.

Superior Hydraulics
Cleveland, Ohio

Circle **300** on Time-Saver Card

AIRLINE COUPLERS
. . . interchange with similar types

Designation: Hi-Flo

Features: One-hand operation. Check unit and adapter snap together, don't pull apart accidentally. Heavy knurled sleeve on check unit for nonslip action. Unit has three parts: spring, deflator, and washer. Swivels when connected to line. Corrosion-resistant, case-hardened steel.

Specifications: Flow is 65 cfm at 100 psi.

A. Schrader's Son
Div. Scovill Mfg. Co.
Brooklyn, N. Y.

Circle **301** on Time-Saver Card

2000-PSI FLUID FILTER
. . . has indicator needle

Designation: Tell-Tale In-Line

Features: Needle tells when cleaning needed. Easy access to cartridge. Full-flow filtering. Full by-pass. Adjustable maximum pressure drop

control. Can be used with flowmeter to spot check flow rates.

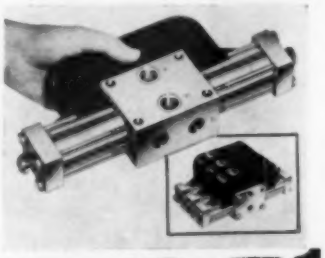
Specifications: 7 media cover 10-238-micron range.

Rosaen Co.
Hazel Park, Mich.

Circle **302** on Time-Saver Card

4-WAY A-C SOLENOID VALVES
. . . eliminate inrush current

Features: No excessive heating with fast cycling. Rates over 60 cpm are practical. All working parts immersed in hydraulic fluid. No moving seals. 3000-psi rated pressure may be applied to all ports. Direct—actuated spool needs no



back pressure or minimum flow for proper operation. Spools are hydraulically balanced in any position. Closed—center, tandem, and two-position designs. Pressure and return ports recessed for stacking, banking. Tie-rod and seal kits for stacking and banking available.

Specifications: Valve shown weighs less than 5 lb., including its two solenoids. In ⅜" pipe size. Pressure drop is 60 psi at 5 gpm. For 110 or 220 v, using same coils for any frequency, 25-60 cps. Power consumption 25 watts per coil at all voltages.

Waterman Hydraulics Corp.
Evanston, Ill.

Circle **303** on Time-Saver Card

ELECTRIC GEAR MOTORS
. . . have highly honed gears

Designation: Synchrogear

Features: Eeach set of gears noise—tested together for mesh and finish. Microscopic nicks, mars, and tooth profile variations detected. Use of honed gears makes quieter, longer-lasting motors. Gears shaven, heat-treated, and honed.

U. S. Electrical Motors, Inc.
Los Angeles, Calif.

Circle **304** on Time-Saver Card

For more NEW PRODUCTS reviews turn to page 112

Bet your boots we make 'em

Steering knuckle drag link boot
Universal joint cover
Bellows cover for sliding ways
C/R
Coated fabric cylinder rod boot
Hydraulic jack cylinder rod boot

Custom-designed and engineered to fit mechanical giants or midgets

Whether you want a boot two stories high . . . or no bigger than your thumb . . . let C/R Sirvis engineers solve the problem for you. They're specialists . . . backed by 78 years' experience . . . with unusual skills and ingenuity in the development and manufacture of mechanical boots. They'll design and produce a C/R Sirvis boot to your exact requirements in any size, any quantity . . . using only the finest materials: mechanical leather, selected, tanned and treated by C/R . . . nylon . . . or elastomer-coated fabric. The absolute dependability of your boot will be proved before production.

So, whenever your problem involves the protection of eccentric, reciprocating or universal action . . . call on C/R. Write us for complete information.

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ADEL...offers you *single source* responsibility

for precision hydraulic control valves

4-WAY SELECTOR VALVES IN A VARIETY OF MODELS TO MEET ALL OPERATING REQUIREMENTS

a complete line for every application

GENERAL SPECIFICATIONS

FLUID: Oil, for hydraulic use only.
PRESSURE: 1500 psi maximum.
FLOW: 3 to 28 gpm.
PORT SIZES: ¼ to 1" pipe size.
MATERIAL: Slides and spools—hardened steel; bodies—gray iron castings.
Various forms of return springs or detents for slide positioning.

MODELS

Lever-Operated For Hand Control. Stem-Operated For Remote Manual Control.

Solenoid-Operated in Various DC and AC Voltages.

Pilot-Operated For Remote Hydraulic Control.

rugged simplicity for efficient, long, reliable service life

These compact, 4-way selector valves are used for control of double acting, or single acting cylinders. Simple spool-type construction provides a wide variety of porting arrangements for either open-center or closed-center hydraulic systems.

The Valves With Maximum Operating Efficiency Over The Years
***Let ADEL be your* single-source *for* precision hydraulic equipment**
Write for valve brochure containing complete specifications.

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QUALITY BUILT-IN! Republic ELECTRUNITE® Hydraulic Line Tubing is produced from highest quality flat-rolled open-hearth steel, carefully checked at every step of manufacturing as only flat-rolled steel can be checked.

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QUALITY IDENTIFIED! New blue spiral markings on every length of ELECTRUNITE identify the quality you specified. The initial cost is the same, but ELECTRUNITE is worth so much more. Call your Republic ELECTRUNITE representative, or send coupon for complete information.

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FLUID CONTROL VALVES

For vacuum, air, water, oil. 3 and 4-way. Pressures from vacuum to 1500 psi. Built-in pressure relief, metering. Lever, button, and double solenoid 4-way valves have closed center neutral position when actuator is centered. Valves have adapter plates to operate combinations of single or double cylinders without tees. Mount on manifold blocks, sub-plates, or pipes. 3-way valves may be sandwiched. Drawings, dimensions. *Gabriel Co., Cleveland, Ohio.*

Circle **400** on Time-Saver Card

ELBOW HOSE FITTINGS

Flared-tube, elbow fittings for narrow or confined spaces. No need for straight fittings and elbow adapter combinations. For medium and high-pressure. Bulletin S-4. *Stratoflex, Inc., Ft. Worth, Texas.*

Circle **401** on Time-Saver Card

GEAR PUMPS

Bulletin 42 has tables which give dimensions, capacities from ½ to 146 gpm, horsepower ratings, pressures to 2000 psi, and rpm. Cutaway shows design features. *Northern Ordnance, Inc., Subs. Northern Pump Co., Minneapolis, Minnesota.*

Circle **402** on Time-Saver Card

HYDRAULIC FILTER

In-line filters for pressure or suction side of pump. Choice of sintered metal or wire cloth elements. To clean, no need to disassemble piping system or drain sump tank. Simplifies original piping and system maintenance. Two in-ports, one out-port. Extra port plug included. By-pass valve, sight-glass, inspection port plug available. Maximum operating pressure 150 psig. Six models have ratings of 10, 20, 40 gpm. For 1¼", 1½" pipe size. Dimensions are 5" x 11", 11¾", 20¼". Bulletin IL-F605. *Arrow Tools, Inc., Chicago, Ill.*

Circle **403** on Time-Saver Card

SERVO COMPONENTS

Book shows engineering and production facilities of four plants and research laboratory. Photos and descriptions of servovalves, valve-cylinder-feedback units, and systems. Facilities covered from R&D to manufacturing, assembling, and testing. 24 pages. *Moog Servocontrols, Inc., East Aurora, N.Y.*

Circle **404** on Time-Saver Card

HYDRAULIC CYLINDERS

Interchangeable, high-pressure cylinders in 12 bore sizes from 1⅛" to 12". 23 mounting styles, 4 rod ends. For 2000 psi, or 3000 psi nonshock. Catalog-Engineering Guide #117 has all design information on one printed side, 39" x 11". Hydraulic pressure and flow

data, method of calculating forces needed for acceleration and deceleration, and figures and table for oversized rod and stop tube applications. 12 pages. *S-P Mfg. Corp., Cleveland, Ohio.*

Circle **405** on Time-Saver Card

PLASTIC AIR HOSE

Resists oil and grease. Doesn't collapse under vacuum. Rated to 125-psi operating pressure. Calculated air flow at 125 psi: 3/16" ID, 27.4 cfm; 9/32" ID, 58.7 cfm; 3/8" ID, 159.6 cfm; ½" ID, 347.0 cfm. Resists abrasion. Bulletin 10. *Munray Products, Inc., Cleveland, Ohio.*

Circle **406** on Time-Saver Card

SEAMLESS MECHANICAL TUBING

Technical Data Card 193 discusses advantages of alloy steel. Carburizing grade, 4620, resists warpage and distortion during heat treatment. Not subject to embrittlement from carbides or soft surfaces. Mixed furnace loads can be heat treated. Full hardening grade, 4340, is machinable to 450 Brinell hardness. For quench-and-temper end-use. Alloy analyses and thermal treatment data given. *Babcock & Wilcox Co., Tubular Products Div., Beaver Falls, Pa.*

Circle **407** on Time-Saver Card

INDUSTRIAL CONTROLS

Catalog lists temperature, pressure, level and flow controls. Describes actuators, controller indicators, and pressure indicators. Section covers electro-hydraulic actuators. *General Controls Co., Glendale, Calif.*

Circle **408** on Time-Saver Card

METERING PUMP

For metering or proportioning. Pressure-loaded, pneumatically powered piston operates positive-displacement, pump plunger. Pneumatic oscillator controls action. No electrical equipment needed. To adjust pumping rate, change plunger's stroke length, or vary number of

Continued on page 54

Use Snap-Tite Valved Couplings and you'll always know when you've stopped the flow!

Use Snap-Tite valved couplings and you'll never have to test lines to see if flow has stopped as you do with conventional valves.

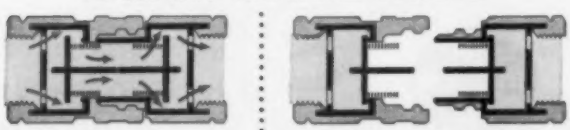
The instant you disconnect the two halves of a Snap-Tite coupling, flow stops . . . and you know at a glance the line is closed. Reconnect and right away full flow begins again.

Snap-Tite couplings take up less space, prevent the possibility of leaking valves, save time and money in installation and maintenance. Ask your local Snap-Tite representative how much you can save by using Snap-Tite couplings.

SIZES: ¼" to 6" in aluminum, brass, steel and 303 and 316 stainless. Larger sizes and other metals on special order.

For more information, write for Snap-Tite Catalog #58. Ask for the name of your local Snap-Tite representative.

TO USE SNAP-TITE VALVED COUPLING:



CONNECT—Full flow instantly

DISCONNECT—Stop flow instantly

★Snap-tite

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UNION CITY, PA.

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strokes per minute. Stroke length adjusted manually, or by output pressure from pneumatic controller or transmitter. Delivery per stroke cycle is proportional to applied control pressure. To change stroke rate, control pressure signal is interrupted at pre-set intervals by 3-way load valve in oscillator. Pumps' maximum capacities from .12 to 82.5 gph. Cylinder piston and pump plunger positioning accurate to .002". Uses clean air or noncorrosive gas at 80 psig. Bulletin P-21. *Associated Control Equipment, Inc., Corapolis, Pa.*

Circle **409** on Time-Saver Card

3-WAY SOLENOID VALVES

Small valves for water to 100 F, and air, gases, and light hydraulic oil to 180 F. ¼"-diameter exhaust orifice is integral part of body. No need for quick-bleed valve to speed up exhaust cycle. 3/32" pressure orifice. ¼" NPT at all connections. Integral, crown type seats. Discs are nylon for tight seating. Power consumption is 10.5 watts ac. All voltages and frequencies to 550 v, 60 cps. Brass bar stock body. Packless. Mounts in any position. Bulletin 8317. *Automatic Switch Co., Florham Park, N. J.*

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2000-PSI CYLINDERS

Single-acting cylinders in 2" to 8" plunger OD sizes. Double-acting cylinders have 2" to 8" diameter bores. Chrome-plated piston rods. Double-ended cylinders available. Telescopic cylinders are single-acting, double-acting, or double-ended. 2-to-5-sleeve units have 2"-to-12" plunger OD. Rod end styles: plain, pin-eye, threaded, clevis. Cylinder tube ends: plain, foot, base, pin-eye. *Universal Hydraulics, Div. Holan Corp., Subs. Ohio Brass Co., Willoughby, Ohio.*

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SAFETY HEAD ASSEMBLIES

Have precious metal rupture discs. Used when clogging of mechanical elements and relief opening space makes use of relief valves alone hazardous. No mechanical parts. Guaranteed to burst within 5% specified pressure at 72 F. Catalog 459 has drawings, dimensions. *High Pressure Equipment Co., Erie, Pa.*

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Plastic material is color-coded according to thickness. It is impervious to oils and greases at boiling temperatures. Doesn't swell, tear, or distort after long use. In roll or sheet form. Standard sheet dimensions: 20" x 50", 10" x 50", 5" x 50". Twelve thicknesses from .001" to .03". Reference card matches each gage to its color. *General Gasket, Inc., Middletown, Conn.*

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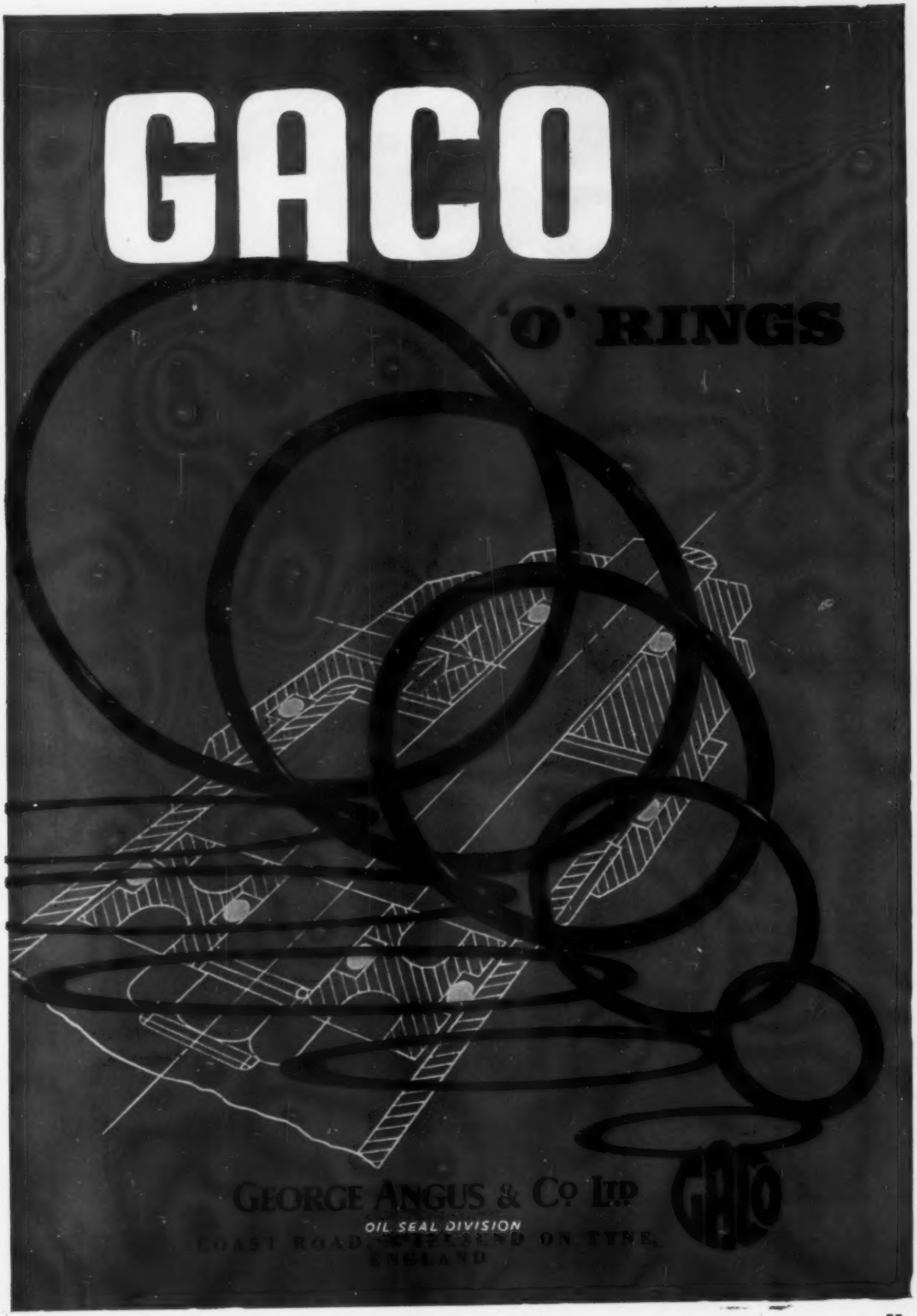

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DO YOUR MOLDED COMPONENTS GIVE YOU HEADACHES?

Compound dilemmas? Should it be Neoprene . . . Buna-N . . . VITON* . . . Silicon or Polyacrylic? How about temperature . . . below zero or sizzling? Unusual pressure conditions? . . . or perhaps a highly destructive hydraulic fluid?

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Strict attention to detail is an IPC hallmark. We welcome problem solving. Ask your IPC representative to show you samples of some unusual headaches we've cured.

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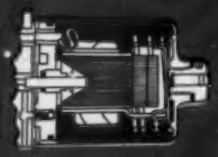
P-2

RACINE-SECO

VERSATILE

4-WAY HYDRAULIC DIRECTIONAL CONTROLS



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- Design conforms to J.I.C. standards
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- Oil immersed solenoids available
- Sub-plate mountings on all sizes

From a design and operational consideration these RACINE-SECO valves are the finest directional controls made. Compact streamlined design — dust proof construction. RACINE-SECO 4-way valves are available in single solenoid spring return and double solenoid standard action or spring centering.

Sizes ¼", ¾" and 1¼" up to 2000 psi.

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VICKERS® Hydraulics and Alternating Current • keep capital investment low • speed cargo handling

Take advantage of Vickers hydraulics when you design or build a vessel. It offers the *infinitely variable speed control* needed for cargo handling *plus* savings that result when AC current is used exclusively on a vessel.

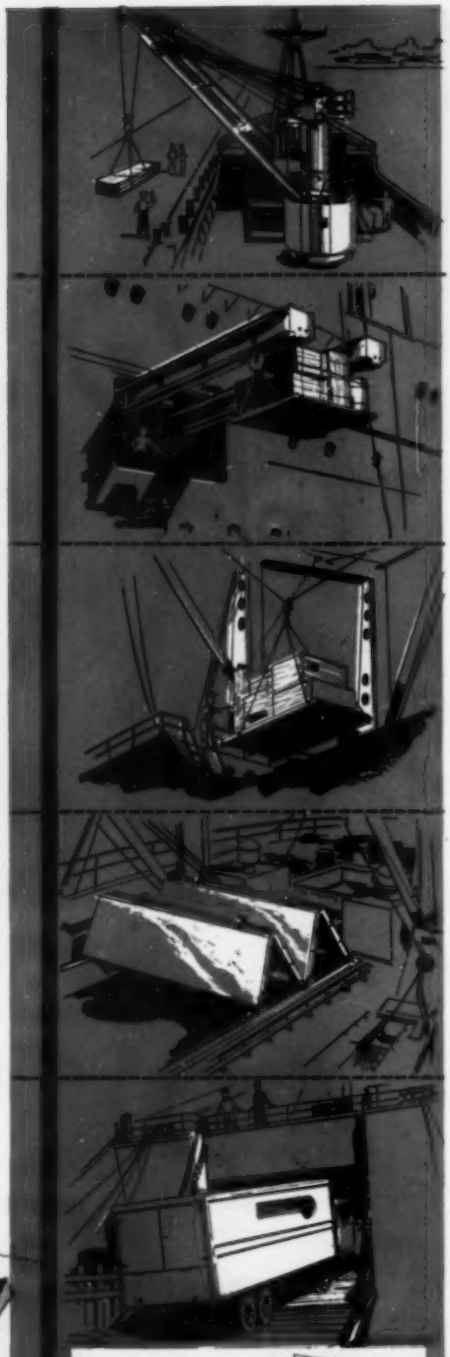
Hydraulics reduces electrical investment — With hydraulics and an all AC system, generators are simpler and less expensive. Dual generator systems, complicated switchboards and switch gear are automatically eliminated. Less wiring is required. Motors, appliances — even lamp bulbs — cost less.

Hydraulics speeds cargo handling — Users have proved that more cargo can be moved per watch with hydraulically powered handling equipment. The reason? Acceleration and deceleration is faster, smoother than any other drive. Reversal is virtually instantaneous. Infinitely variable speed control is an inherent characteristic of these drives.

Hydraulics improves space utilization — Per unit of bulk or weight, hydraulic units give *more power* than any other drive. Thus, cargo-handling equipment can be extremely compact. Furthermore, the valuable below-deck space required for operation of old style variable speed devices can be released for cargo.

Hydraulics permits design flexibility — Hydraulic motor (or pump) can be mounted in any plane. Shafts can be horizontal, vertical or at any angle. Pumps can be located remotely. Steel tubing between units is run like cable — around corners or through bulkheads.

Vickers has engineered hydraulic systems for practically all of the modern cargo-handling devices from conventional winches to "lift on-lift off" gantries. This experience is available to you. A team of hydraulic specialists is "on call" to work directly with your engineers. Phone, wire or write today!



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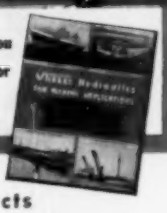

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APPLIED Hydraulics & Pneumatics
FEBRUARY 1960

An old field for hydraulics gets a new look

SOME of the first applications of high pressure, oil-hydraulic systems were on naval ships. In the early 1900's large axial piston pumps were powering gun positioners and steering gear. While the value of hydraulics in performing these operations has long been recognized, ship builders have been slow in using new ideas in hydraulic circuitry.

This article reports the highlights of papers and discussion given in November at the first Marine and Naval Hydraulics Conference sponsored by Vickers Inc. More than 150 engineers employed by ship designers, builders, operators, and deck equipment manufacturers exchanged ideas about the design and use of oil-powered machinery. Guiding this discussion were moderators L. P. Adair, senior naval architect, J. J. Henry Co. and Capt. J. M. Reigart, Bureau of Ships.

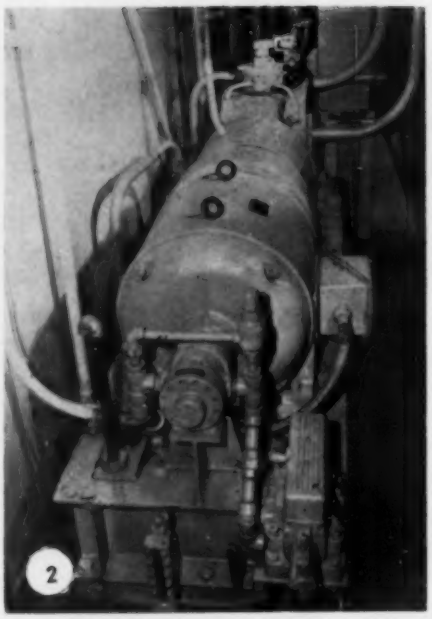
• **What the Navy is doing**—In the long list of uses for oil power on naval ships are:

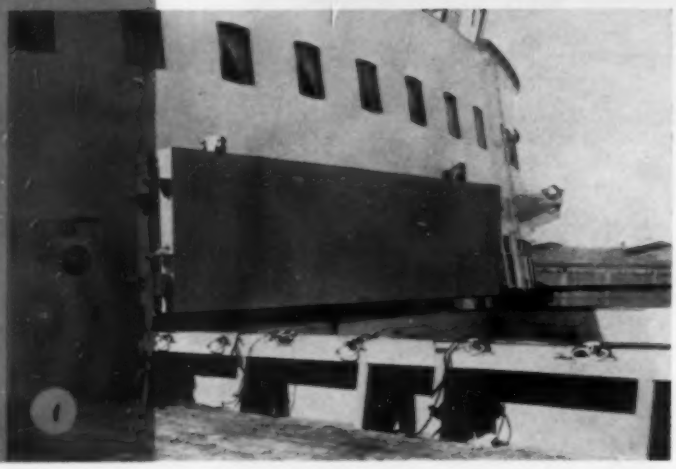
- cranes, hoists, winches,
- capstans, windlasses, elevators,
- steering and diving gear,
- missile handling and launching,
- ship stabilization, variable pitch propellers,
- variable frequency generator drives,
- propulsion clutch controls, radar drives,
- landing ramps and turbine speed governors

N. E. Wenger, supervisory mechanical engineer, Bureau of Ships, described several circuits now being used: a 2800-psi, automatic highline and loadline tensioning winch; the central 3000-psi power unit on submarines which serves about 70 operations; a 1300-psi secondary system on subs for raising and lowering masts; and a rocket launcher.

How do hydraulic components for naval use differ from industrial designs? Except for shock resistant requirements, Wenger said valves for surface ships are industrial types. Subs need low leakage valves with manual override on solenoid or pilot-operated types. Valves for submarines use non-ferrous and corrosion resistant materials. They are designed with spool and sleeve for close manufacturing tolerances.

Here's what oil power is doing on luxury liners





Submarines use monel or stainless reservoirs. Accumulators are piston or non-separator type. On subs, 70-30 copper-nickel tubing is used. Fittings are welding neck or silbray flanges or socket types with pre-inserted brazing rings. Flanges take O-rings. Flareless, bite type fittings are also used.

Where necessary, salt water cooling with double tube, sheet heat exchangers is used.

Where flexible connections are needed on warship hydraulics, the trend is toward swivel fittings.

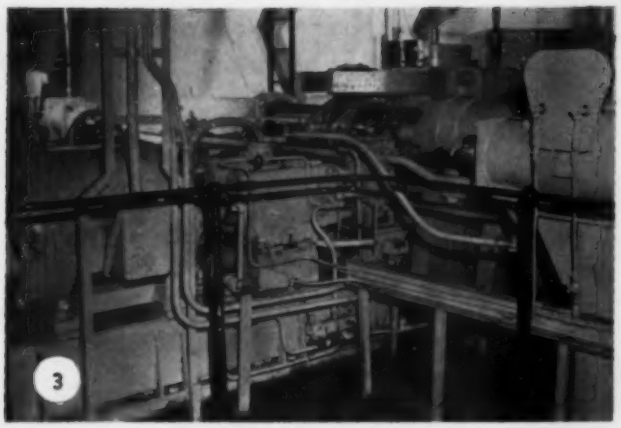
Industrial standards are followed for most cylinders and packings.

• **Progress on liners and cargo ships**—Two new Moore-McCormack luxury liners, the *S. S. Argentina* and *S. S. Brasil* make great use of hydraulics. H. R. Glennon, Jr., vice president of the lines, said the hydraulic systems met expectations. What made hydraulics attractive to ship owners? Hydraulically powered winches really became attractive when an a-c electrical system proved far superior to d-c systems for ship operations. Without d-c current it is hard to control speed. Shipowners teamed a-c motors with hydraulic drives. This combination is reliable and flexible. The drives save space.

Hydraulic winches are instantly reversible with fast acceleration and deceleration. The operator "feels" the load, while having stepless speed control and fast response. Hydraulic power has proved safe, holding a load if power fails, and refusing excessive loads without danger of motor burnout.

There have been minor troubles. An oil having a broad temperature range corrected a failure caused by fluid congealing in sub-zero weather. Dirt which had gotten into the system during installation caused a tubing failure in the steering gear. Proper flushing and part replacement solved this problem.

Rounding up spare parts is the hardest job. Glennon thinks there are too many differences in fittings,

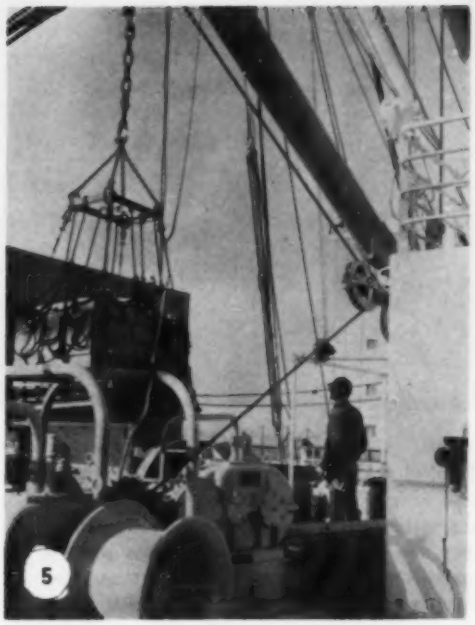


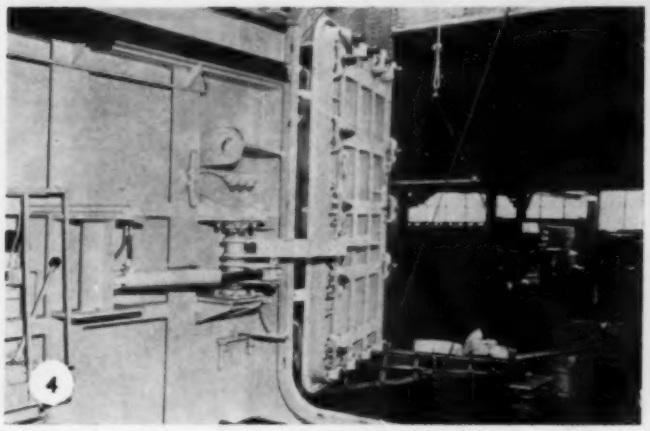
1 **HATCH COVERS** open and close with hydraulic power. These automatic folding hatch covers replace covers which had to be lifted by crane and stacked on the deck. Electric push buttons control operation.

2 **FIN STABILIZATION,** powered by this hydraulic power unit, eliminates as much as 90% of the roll that would otherwise be experienced in rough seas.

3 **STEERING** is powered by this large axial piston pump. Rudder position is altered by changes in delivery.

4 **SIDEPORT HATCHES** open easily with hydraulics. At sea they are locked watertight against waves.





5 **WINCH** is driven by variable speed, hydraulic transmission. Alternating current ships make these winches attractive. They also save fuel compared to d-c winches. That's because they don't create load surges and the fuel demand resulting from simultaneous operation of many d-c winches.

threads and O-rings. He asked for greater standardization on threads, shoulders and tolerances and better identification of fittings and packings.

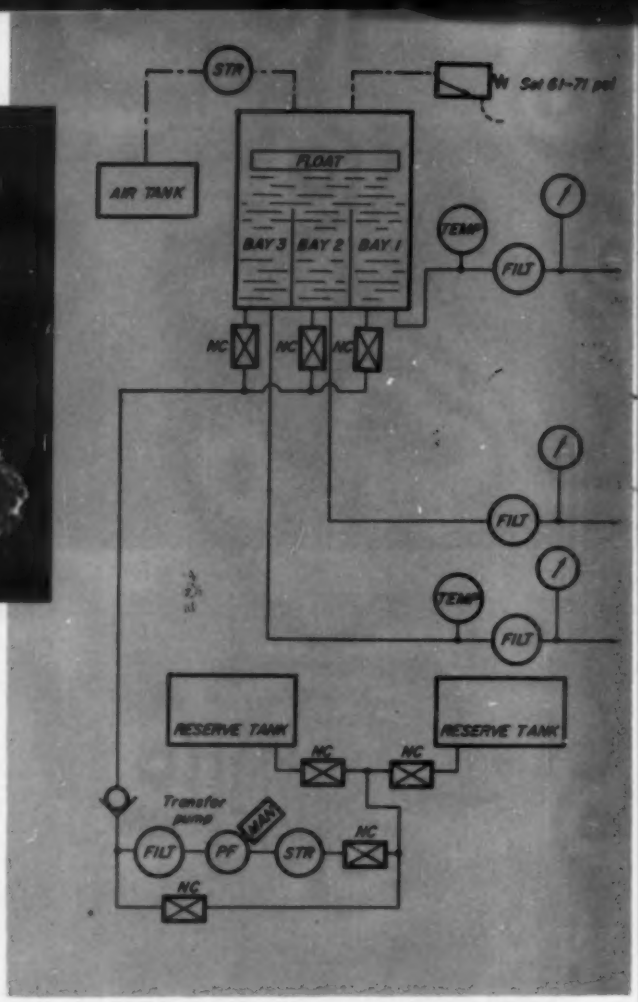
• **Servo systems**—Ship steering and motion control are fine jobs for servos. Fred Brand, engineering department head, Sperry-Piedmont Company, explained some of these systems. Noise reduction on submarine hydraulic systems is required. This has led to use of constant pressure, accumulator systems instead of the more efficient and economical variable-delivery pump systems.

On ships, servovalves and variable delivery pumps handling 100 hp are common.

• **Deck machinery**—Because shock and performance requirements for naval use are more severe than commercial service, the Navy has made greater use of hydraulics for deck equipment. Western Gear's R. T. Hawley pointed to ship equipment spec writers lack of know-how as one reason why hydraulic drives have not been more widely used for deck machinery on commercial ships. He emphasized that specification of maximum performance in terms of speed and load are important to proper hydraulic system selection. Occasional peak overload condition should not be specified as the normal operating cycle.

• **Pressurized reservoirs**—Designers of marine hydraulic systems are interested in pressurized reservoirs. They don't have vent caps, which are a source of contamination by sea water. Pressurization also helps reduce air entrainment in the oil. One designer told of using a nitrogen flask with a reducer to maintain 5 psi. Pressurizing with gas can cause pump cavitation unless care is taken.

• **Future for control systems**—To isolate the noise source, central hydraulic power systems are used on subs. To apply these to tankers presents problems. Piping losses, control difficulties, and dirt are the bugs. ▼▼▼



Submarine hydraulics . . . designing for safety and silence

SILENTLY gliding under the surface, a *Polaris*-firing submarine might receive a sudden message to attack. Information about the ship's position relative to targets has been constantly feeding into its 16 missiles. Within seconds, the first missile might be fired and on its way to a target as far as 1500 miles away.

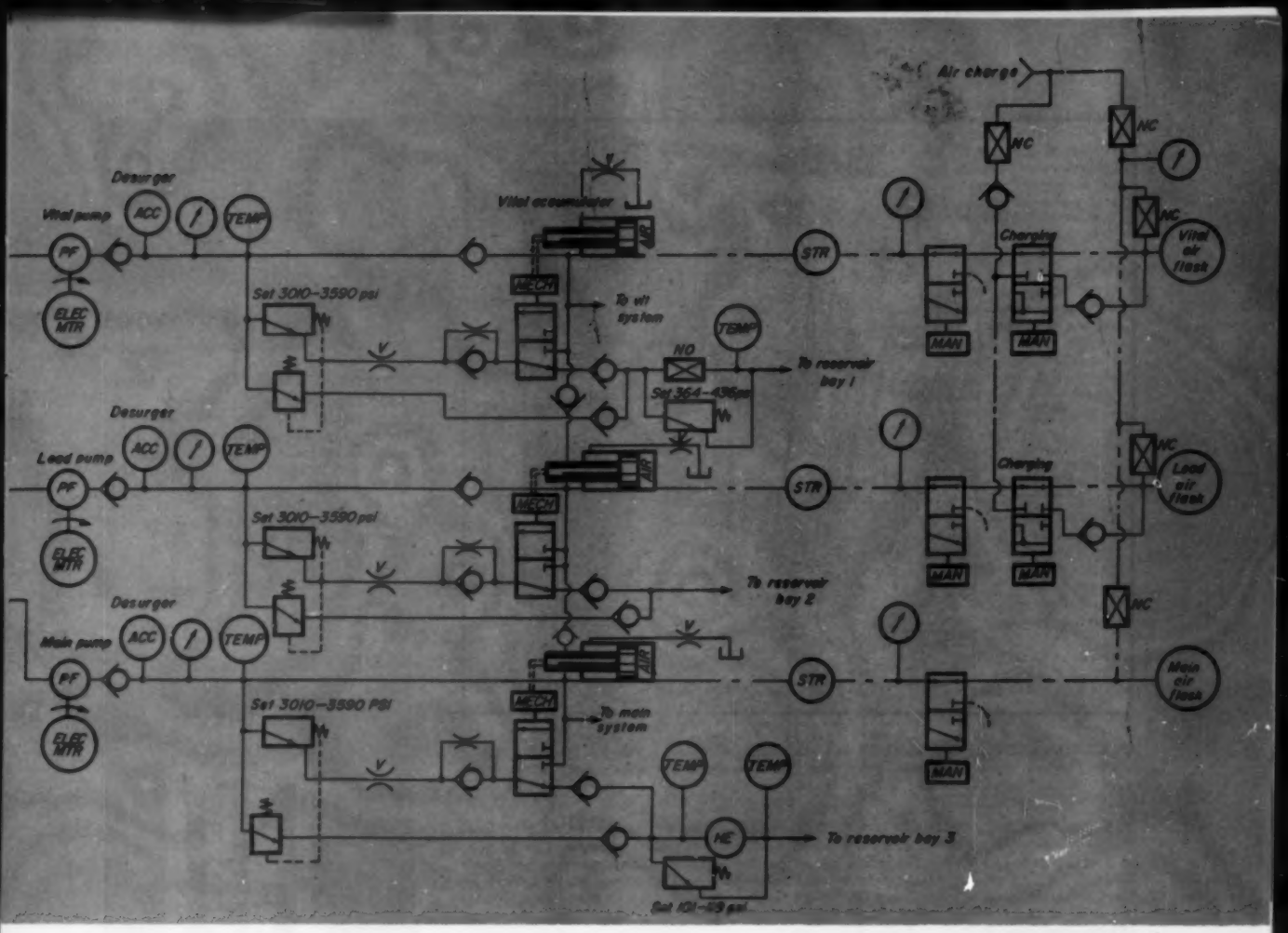
Hydraulics is as important to this mission as the ship's nuclear reactor itself. Diving and steering planes, ballast tank valves, masts, torpedo tubes, and many other functions are operated hydraulically.

Two principles guide the submarine designer: reliability and low noise level. The hydraulic system has many fail-safe features to insure safety of the crew and equipment, and completion of the mission.

Low noise level requires use of certain components which in turn present design problems. For instance, screw type pumps are best from a noise standpoint, but they have comparatively high slip and low efficiency which produce heat. Thermometers sensing pump output temperature tell when the pumps need repair.

• **Three pump-accumulator systems**—A *main* system, a *vital* system, and a *lead* system supply fluid at 3000 psi to the various ship operations. They are designed for reliability, with the vital system supplying

Technical assistance by WALTER TISDALE *and* EDWARD BEHNEY, *Electric Boat Div., General Dynamics Corp., Groton, Connecticut.*



those functions which must operate in an emergency. The main and vital systems are installed on opposite sides of the ship so that damage to the hull would affect only one of them. They can be connected together in an emergency. The lead system normally supplies both the main and vital systems.

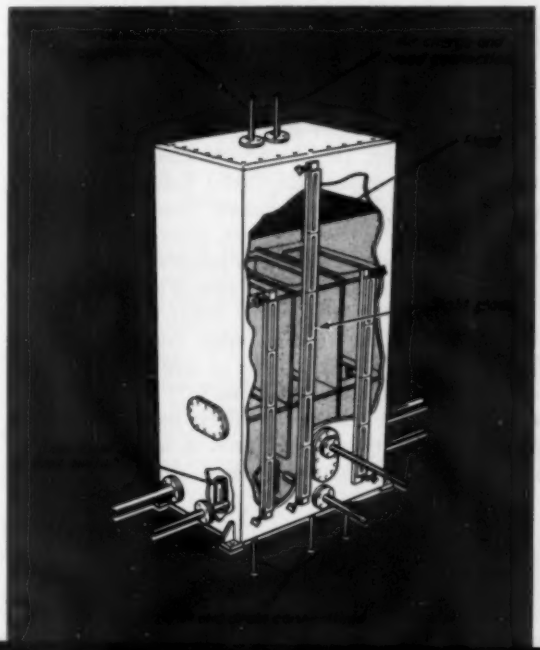
Three pumps draw from individual bays in the 290-gallon, stainless steel reservoir. The bay dividers extend about $\frac{2}{3}$ up from the bottom, so that when fluid level drops below the $\frac{2}{3}$ full point, each pump can draw only from its own bay. This insures that in case of damage to one system, that pump cannot drain the whole reservoir. Low level float switches in each bay shut off that pump to prevent dry operation.

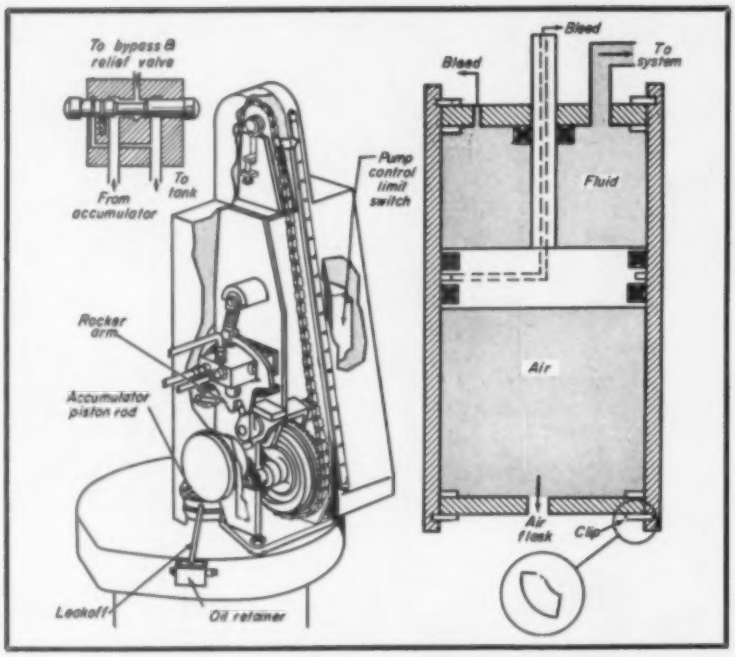
The reservoir is pressurized by 10-35 psi air to prevent pump cavitation which causes noise as well as wear. A relief valve limits air pressure to 66 psi in case of oil surges, air leakage, or thermal expansion. A hand pump, drawing from two reserve tanks, supplies make-up fluid to each reservoir bay.

• **Reducing pulsation and noise**—Desurgers in each pump outlet line reduces pulsation and resulting noise. Each desurger is an inline accumulator made of three concentric parts. Fluid flows through an inner cylinder which has orifices in its wall. The desurger's outer cylinder is fitted with a pressure gage and charg-

THREE PUMP-ACCUMULATOR SYSTEMS power hydraulic functions in a nuclear submarine. Lead system supplies both the vital and main systems which can also supply each other in an emergency. Air valving permits charging to 3000-psi even with low air system pressure.

RESERVOIR IS DIVIDED into three bays to isolate pump supply. A rubber-painted, balsa wood float reduces oil turbulence caused by rapid return flow. The tank is horizontally baffled to reduce foaming. Sight glasses at each bay show fluid level.

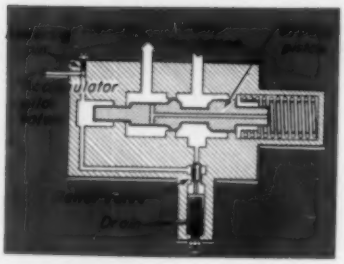




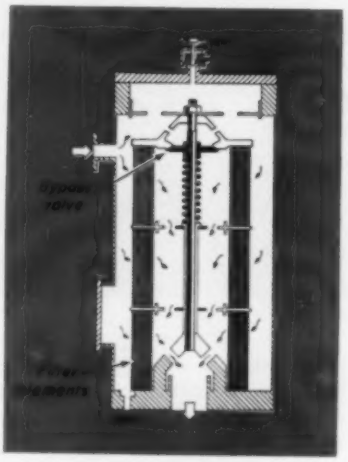
ACCUMULATOR LEVEL SENSOR has a sprocket which is driven by the accumulator piston. When the accumulator is full, the sprocket drives a mechanism to actuate the cam-operated pilot valve and indicating devices.

PISTON TYPE ACCUMULATOR is installed with fluid on top so air can be bled from fluid. Piston is sealed with quad-rings which have proved more successful than O-rings and other designs. A vent line which passes out through the piston prevents mixing air and oil. It also gives an indication of seal condition. Attaching the heads with shear clips as shown gives a more compact design than heads bolted to flanges. Accumulator is stainless steel, ID is electrolyzed for hardness. Piston is monel with a stainless, electrolyzed rod.

FILTERS AT EACH PUMP INLET have three, stacked, micronic elements for a 10-gpm flow. A relief valve in the filter opens at 8-10 psi differential pressure across the filter element and bypasses flow. A venting valve in the top of the filter permits bleeding air after the filter has been installed in the line. Pressure gages between the filters and pumps indicate filter condition, as well as pump inlet pressure.



COMBINATION BYPASS AND RELIEF VALVE controls pump delivery to accumulator or reservoir. When accumulator is fully charged, its pressure is applied to port at left. This shifts spool to right, and connects pump flow to tank. Relief valve is set at 3010 to 3590 psi. When its poppet opens, pressure is applied to left end of spool, shifting it to pass pump flow to tank.



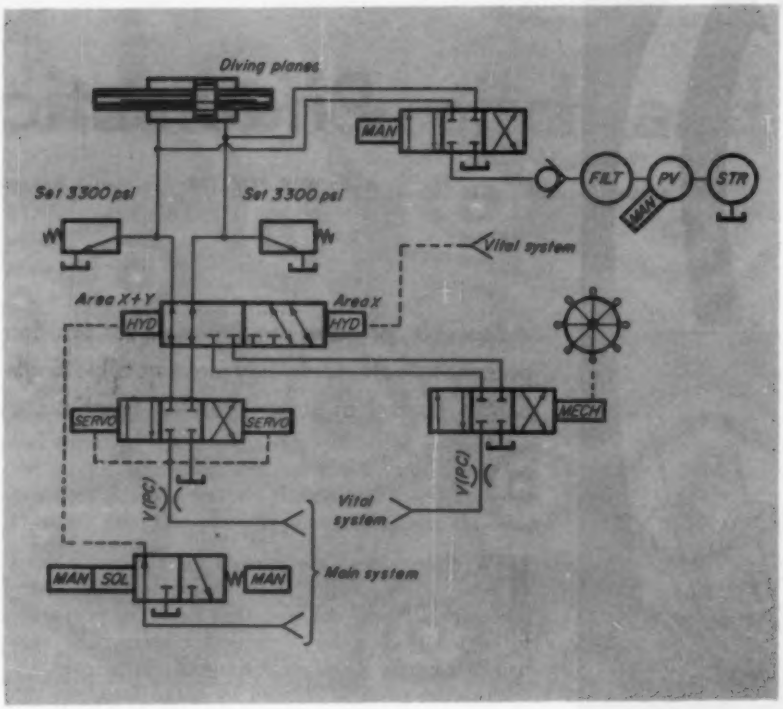
ing valve. A flexible sleeve separates the inner and outer cylinder and forms the fluid section and nitrogen section of an accumulator. Nitrogen precharge is 800-1200 psi. A 670-cu. in. nitrogen flask charged to 2000 psi is located near the desurgers.

The screw type pumps are driven by electric motors at 3600 rpm and deliver 30 gpm at 3000 psi with 70% to 75% efficiency. This delivery is adequate for steering and diving without additional fluid form the accumulator. As the screw pumps wear, slippage increases, but this is hard to detect, from reduced pump delivery. Thermometers at each pump's inlet and outlet indicate how much heat the pump is putting into the fluid because of wasted energy (slip). This temperature difference tells when to repair the pump. To reduce pumping noise each pump is resiliently mounted and has flexible hose connections.

• **Accumulator charging**—Each pump charges a separate, piston type accumulator. A level control on each accumulator bypasses pump delivery back to reservoir when the accumulator reaches 95% ±2% full. The control directs pump delivery to the accumulator when accumulator level drops to 40 ±2% full. This accumulator control is preferred to pressure sensing because it is a more positive way to insure adequate capacity for peak requirements. Pressure sensing is affected by temperature variations, and air pressure charge on the accumulator is more critical.

A 3-way pilot valve, cam-operated by the accumulator's level control, applies accumulator pressure to open the pump unloading valve, directing pump delivery back to reservoir at low pressure.

Both the vital and the main accumulators are identical, but the lead accumulator has a larger rod, so that it is the first to charge and discharge. Because each pump delivers the same amount of fluid, the lead accumulator fills first because of its smaller volume. It also discharges first because it delivers the same amount of fluid from a smaller volume. Keeping the lead accumulator "out of phase" with the other

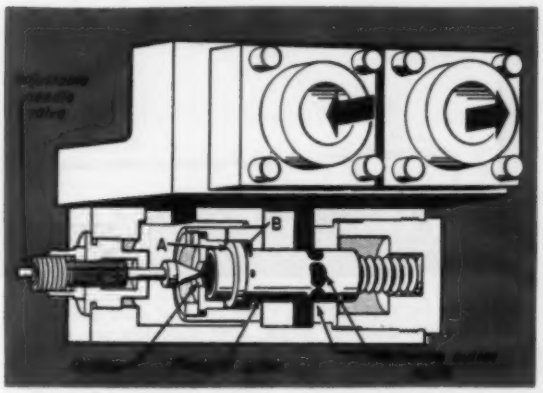


STERN DIVING PLANES are driven at 5-9 degrees/sec by a double rod end cylinder for equal speed and force in both directions. Normally, a synchro at the steering wheel supplies an input signal to a magnetic amplifier which compares it with a feedback signal from the plane actuator. The difference (error) is applied to the servo valve to control actuator flow. The valve is sized large for low velocity and noise.

The 6-way valve is held in the position shown by main system pressure. If main system pressure falls below 1500 psi, 3000-psi vital system pressure acting on twice the area in the 6-way valve shifts the valve for emergency control.

If the main system fails, vital system pressure shifts the 6-way valve. If the servo system fails, the 3-way solenoid valve de-energizes. Thus a shift to manual-hydraulic control is automatic on failure. A switch is also provided permitting manual shift to manual-hydraulic control. The solenoid valve is mounted at the planesman's position, so he can operate it manually if it sticks. He then locks it with a pin.

A manual pump and valve provide a third system to actuate the diving planes. Rudder and bow planes systems are identical to stern planes.



PRESSURE-COMPENSATED, FLOW CONTROL VALVE limits velocity of diving planes. Installed as a meter-in valve, pressure upstream from the orifice is applied against area A; pressure downstream from the orifice, to area B. An increase in load pressure temporarily decreases flow and pressure drop across the orifice. This opens the metering ports to increase flow to its former value. Adjusting knob has enameled grooves to set the valve in 10-gpm increments.

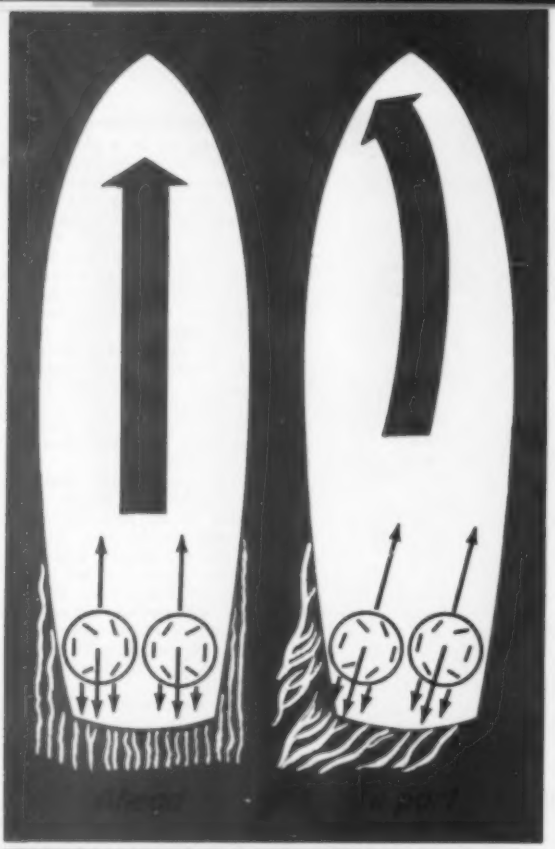
two accumulators insures that all accumulators are not discharged at the same time, and that there is always adequate fluid to meet peak requirements.

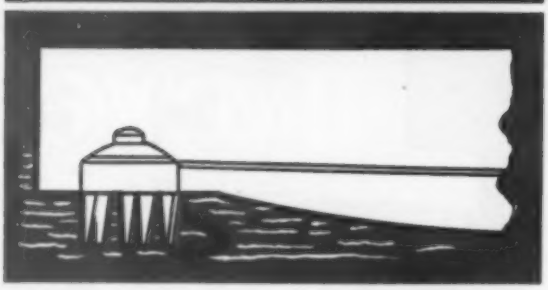
• **Air charging**—Each accumulator has an auxiliary air flask connected through two manual valves. The flasks may have to be re-charged while the submarine is in a location that prevents compressor operation because of noise. A procedure for using the accumulator as a compressor permits air charging to 3000 psi with any available air pressure.

The pump is run long enough to charge the accumulator full of fluid, forcing all its air into the flask. The charging valve in the accumulator-flask line is then actuated, connecting the air supply line to the accumulator and to the air flask. Next, the needle type flow control valve on the accumulator fluid side is cracked, so that the air supply forces the accumulator piston down. When the accumulator is empty, the needle valve is closed and the pump started. This pumps fluid into the accumulator and forces air into the flask where it is held by a check valve. Check valves prevent forcing air into the supply system.

This procedure is repeated until air pressure reaches 3000 psi. If the accumulator is then only partly filled, the pump is cycled and air bled off so that air pressure is 3000 psi with the accumulator full.

In an earlier design, a 2-way valve in the line from the air flask to the accumulator closed off the flask during accumulator maintenance. However, if the 2-way is closed and the accumulator charged, dieseling effect on the air-fluid mixture could cause ignition. A 3-way rotary valve now vents the accumulator and closes off the flask. A rotary valve is used rather than a poppet valve because of low operating torque and superior sealing. Submarine systems are very liable to contamination which damages the soft seat of a poppet valve and causes leakage. ▼▼▼





VERTICAL PROPELLERS work well on shoal draft boats. Even with blades of moderate length, orbit diameters can be large enough to give ample thrust. Propulsive thrust is produced by blades oscillating on their axis as rotor revolves. The ship is steered by setting direction of propeller thrust.

WHY PNEUMATICS?

Low pressure air is available from the ship's air compressor. Because a pneumatic system has no return lines, piping is simplified. Any leakage is easily replaced and does not result in fire hazard or require clean up. Air can be easily stored throughout the ship and provides rapid response. Through flexible pressure adjustment, air safely controls speed and direction of the ship.

Pneumatic

• By **W. R. FORSTER**, *Engineering Manager,*

Adjustable, pressure regulating valves position pneumatic actuators. They make possible single handle control of several related functions.

NEW circuit ideas are applied on a recently developed, army landing craft. A single hand control automatically sets the propeller pitch in proportion to engine loading for a particular speed. The same handle controls direction and speed of the ship.

Propeller pitch is affected by cargo load, sea, and wind conditions. With this pneumatic system, for any given speed, the pitch or engine load is continuously compared to a predetermined optimum engine load and is automatically adjusted.

• **Designed for landing craft**—The boat is the Army's new Beach Discharge Lighter BDL-1X. It has two vertical-axis propellers that drive and also steer. There's no steering rudder. The vertical propeller assembly has a pitch and steering control mechanism, and a rotor containing the blades. These vertical blades oscillate on their axes as the rotor revolves. Propeller pitch is determined by the angle of blade oscillation. The rotor always revolves in the same direction. Varying the pitch of the blades changes the direction of the slipstream and turns the boat. Pacific Car and Foundry Company supplies the propellers. Power for the blade positioning is hydraulic. Control is provided by the pneumatic circuit.

• **Flexible controls**—Small diameter, low pressure air lines are piped from control stations in the pilot house, engine room, and afterdeck to the servo actuators on the propeller housing, All control stations are interlocked so that control functions can be transferred between them. A pressure gage at each station shows supply pressure when that station is in command. Signal lights indicate adequate or depleting air supply. A pressure switch operates the signal lights. Clean, dry air at 125 psi is used.

• **Pressure signals operate servo**—Position of operating actuators is controlled by regulating pressure. The steering and pitch control actuators are air-operated servo devices. Operation, is fully automatic as pilot and mechanical actuation of the valves signal the

controls for pitch and speed

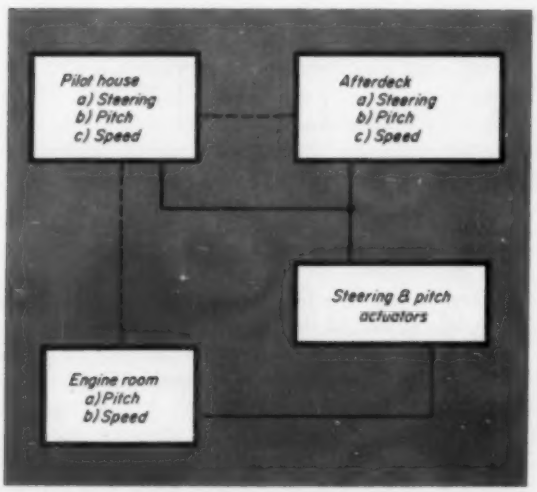
Westinghouse Air Brake Company, Industrial Products Division, Wilmerding, Pa.

servos in response to hand valve position and engine load conditions.

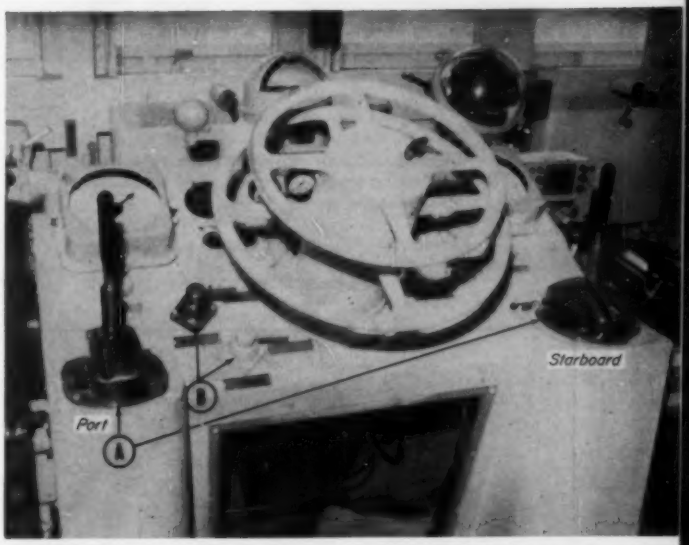
Key element in this control of pitch, speed, and steering is the self-regulating, automatic pressure control valve. Its operation and construction is shown in the circuit schematic and valve cutaway. There are two positioning levers on the control stand for each propeller unit. One controls pitch and speed; the other controls steering.

The single handle valve which controls both pitch and speed is a compound valve including the pressure regulating valve and two, 2-position, 3-way valves. The schematic shows one of the control circuits. Elements of this circuit are duplicated at each console and at each of the two vertical propellers. The circuit is shown in the schematic with the controls in the *ahead* position. Pitch is zero or flat. As the control lever is moved forward from this position, pressure increases in the pitch and speed line. Propeller pitch increases in proportion to the valve handle movement.

• **How pitch reduces when engine overloads**—With less than 10 psi in the pitch and speed line, the propeller is set for zero pitch. At 30 psi, pitch is maximum. Futher movement of control lever increases engine speed from a 325 rpm idle to full at 850 rpm as pressure in the line goes to about 60 psi. This pres-

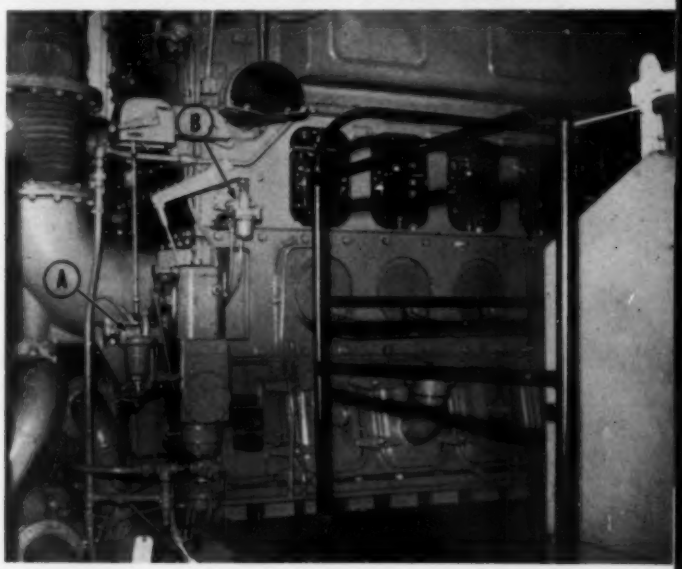


THREE CONTROL consoles are on the ship. Circuit is arranged so that controls shown in this block diagram can be operated from any console.



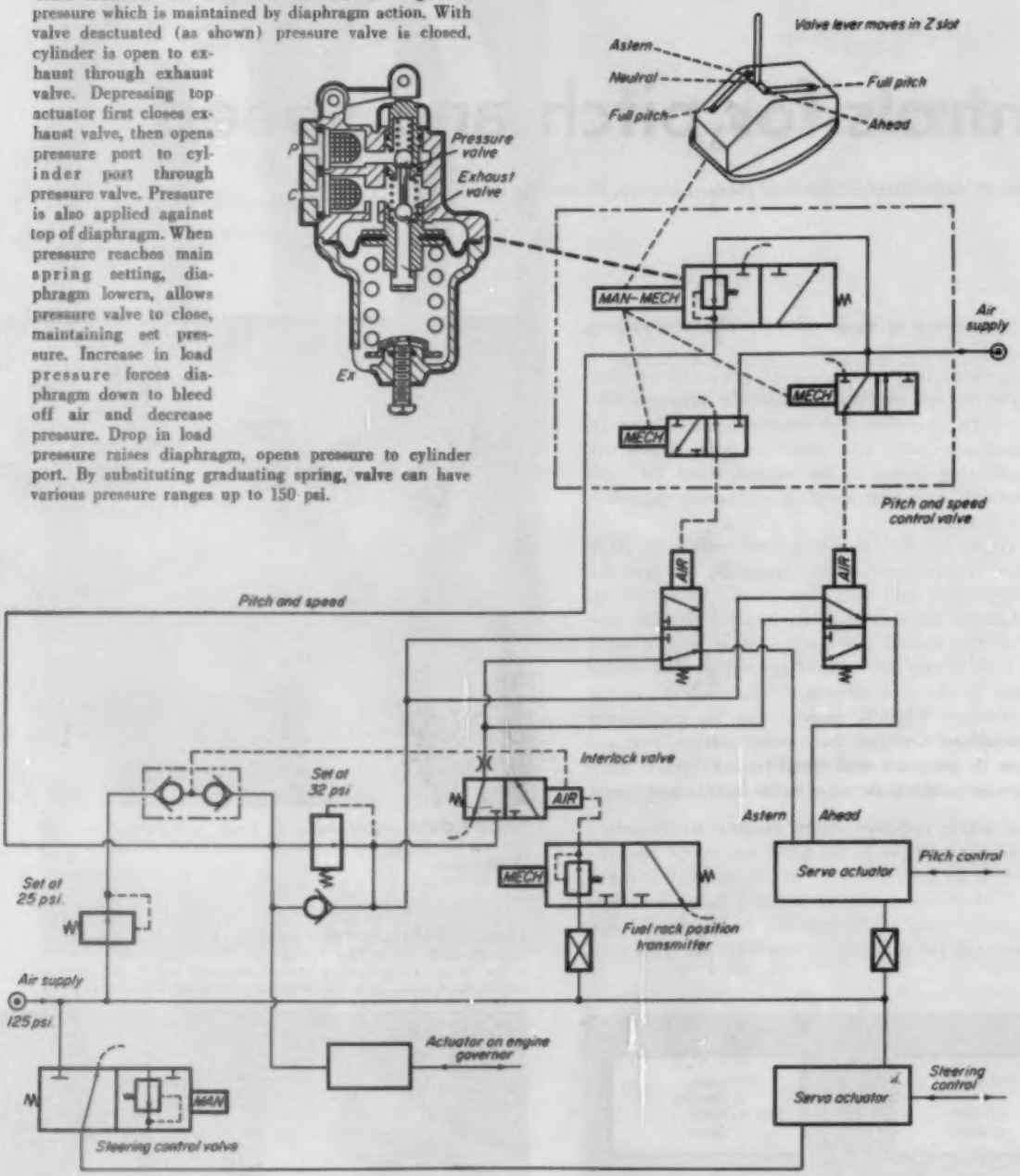
PILOT HOUSE control shows: A) Single level control for pitch and speed. B) Valves for transferring control to engine room or afterdeck.

ENGINE INSTALLATION shows: A) Pneumatic actuator operates throttle, controlling speed. B) Fuel rack position transmitter is an adjustable, pressure regulator which, by sensing engine load, provides a pneumatic signal to alter propeller pitch.



SPEED AND PITCH CONTROL CIRCUIT

CAM ACTION ON TOP OF VALVE sets regulated pressure which is maintained by diaphragm action. With valve deactuated (as shown) pressure valve is closed, cylinder is open to exhaust through exhaust valve. Depressing top actuator first closes exhaust valve, then opens pressure port to cylinder port through pressure valve. Pressure is also applied against top of diaphragm. When pressure reaches main spring setting, diaphragm lowers, allows pressure valve to close, maintaining set pressure. Increase in load pressure forces diaphragm down to bleed off air and decrease pressure. Drop in load pressure raises diaphragm, opens pressure to cylinder port. By substituting graduating spring, valve can have various pressure ranges up to 150 psi.



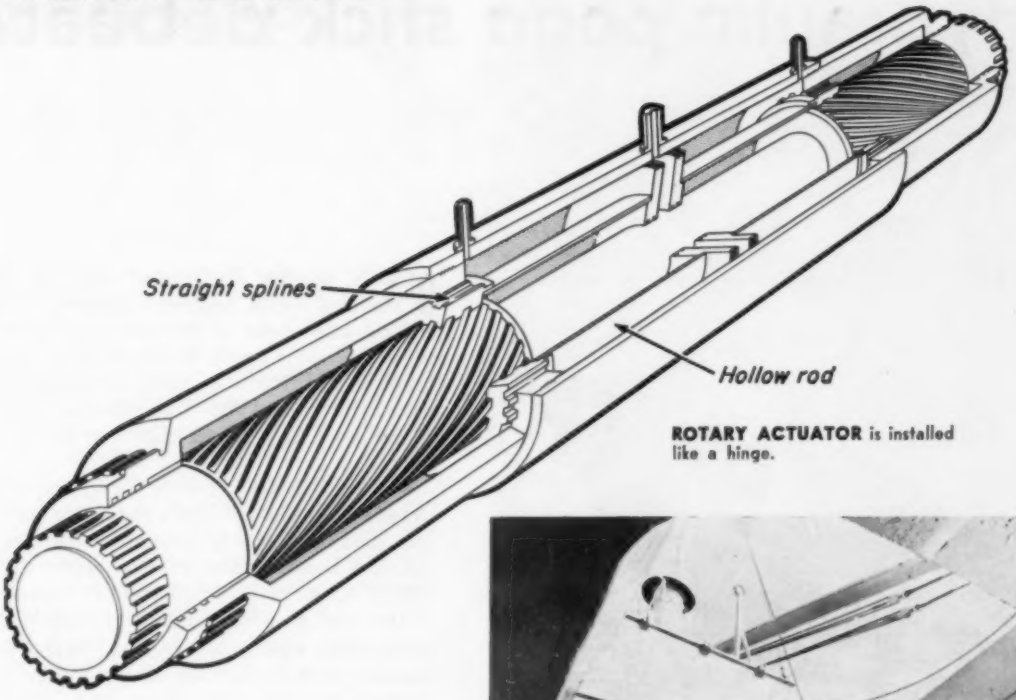
sure powers the throttle actuator to raise speed. If at any given speed the propeller pitch puts to much torque on the engine, a pressure signal reduces the pitch.

An interlock valve is actuated in its pilot chamber by pressure in the pitch and speed line and by a regulated pressure signal from the fuel rack position transmitter valve. When the engine is overloaded, pressure from the transmitter valve exceeds the pressure in the pitch and speed control line. This shifts the interlock valve. The result is a pressure signal on both the *ahead* and *astern* lines of the pitch actuator causing reduction of propeller pitch in proportion to the pressure differential.

There is also overload protection when the engine is at idle speed. At this speed air pressure at 25 psi is applied to one side of the pilot chamber in the interlock valve. This pressure is opposed by a signal from the fuel rack position transmitter. An overload will shift the interlock valve.

Reducing pitch reduces engine load. The fuel rack closes in proportion to reduced load. The pressure signal drops, interlock valve shifts and astern control chamber of pitch actuator is vented. ▼▼▼

Compact rotary actuator operates hatch covers



ROTARY ACTUATOR is installed like a hinge.

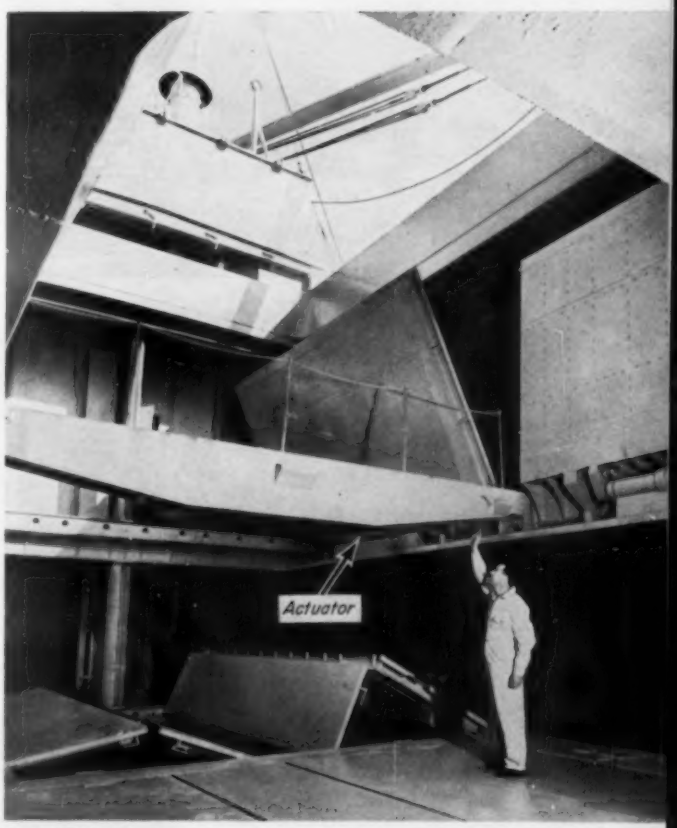
MOST hatch opening and closing gear takes up cargo space, or gets in the way when loading or unloading cargo. This hydraulically powered actuator takes about the same space as an ordinary hinge, It developes 20 ton-ft torque at 1400 psi.

Developed by Gotaverken of Gothenberg, Sweden, the actuator has two opposed pistons attached to hollow rods. The rods are splined to the cylinder to prevent rotation. Also they are helically splined to hinge pins. As the pistons extend or retract, the rods rotate hinge pins at each end of the actuator.

The splines and other internal moving parts are lubricated by oil from the hydraulic system. Pilot check valves prevent the hatch covers from falling if hydraulic pressure to the actuator fails. The valves also allow the cover to be stopped in any position.

Six hydraulic power units located throughout the ship supply power for hatch operation. They can be used independently or as standby for one another. Several hatch covers are controlled from one panel. They take 45 to 60 seconds to open or close.

Larger hatch covers are made in two sections for each door. A 180-degree actuator folds back the inner section before the outer section is rotated open. This reduces torque requirement 60 percent. ▼▼▼



HATCH COVERS require up to 20 ton-ft torque to open. Rotary actuators develop this at 1400 psi, yet do not interfere with loading or storage.

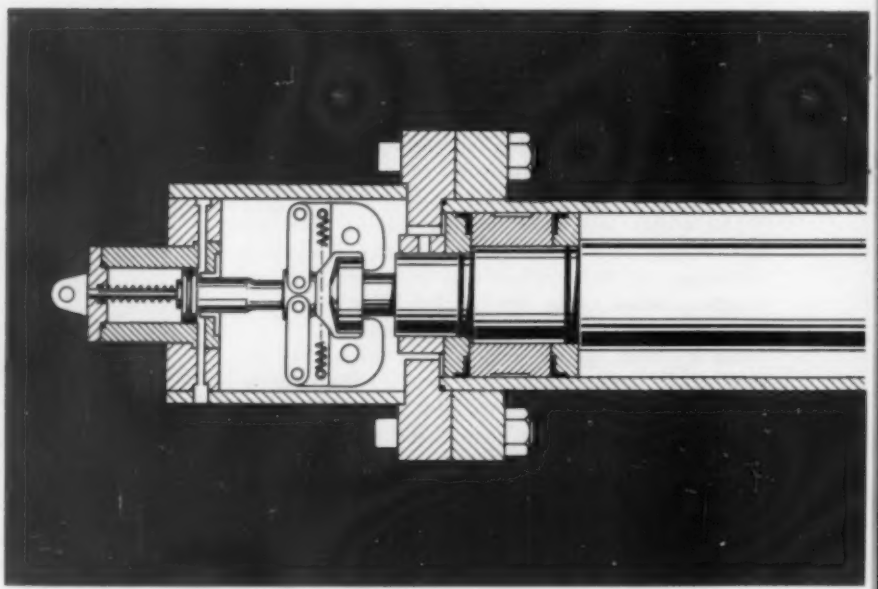
Now, beached ships can be floated to safety with their own equipment. This is how a 1600-ton landing ship can "walk" on a hydraulic piston rod.

Hydraulic pogo stick debeaches

FIRST SHIP to be equipped with hydraulic de-beaching gear is this Army lighter, Lt. Col. John U. D. Page. The bow-mounted ram can shove the vessel off a beach in less than three minutes.

OCEAN beaches are littered with the wrecks of stranded vessels, hopelessly trapped. World War II landing ships were at the mercy of enemy fire because they could not be floated to safety. To solve this problem, the National Steel & Shipbuliding Corp. built a 1600-ton, 338-foot long landing ship, designed to get stuck on a beach and then get unstuck in a hurry.

The ship shoves off with a trunnion-mounted hydraulic jack. The cylinder's piston pushes a ball foot into sand or rock at a 35-degree angle with the vertical. The kneel-mounted cylinder works the ship free with a series of 3-foot strokes. Horizontal thrust is 57,000 pounds. Piston rigidity is assured by keeping stroke short relative to total rod length. Piston bending stresses in the fore and aft plane are eliminated by trunnion-mounting the cylinder in a keel well. Thus, during debeaching the piston moves through a 15-degree arc keeping all thrust forces in line with its axis.



LOCKING MECHANISM of debeaching ram is spring loaded. Hydraulic pressure overpowers coil spring to release piston rod for extension. Lock-up is automatic when cylinder retracts.

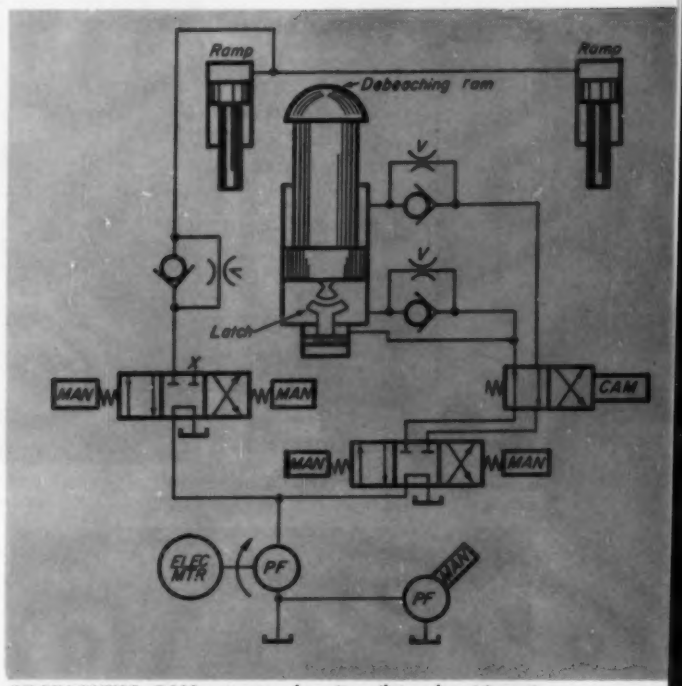
landing ship

The cylinder trunnion is located so that the ball foot which is welded to the end of the piston acts as a ball bearing on the ground—relieving side loading of the piston.

To prevent the piston from swinging beyond an allowable arc limit, a small pilot valve mounted on the trunnion is actuated when the cylinder reaches its arc limit. The valve stops flow in the cylinder. The ram is retracted by manually operating another control valve.

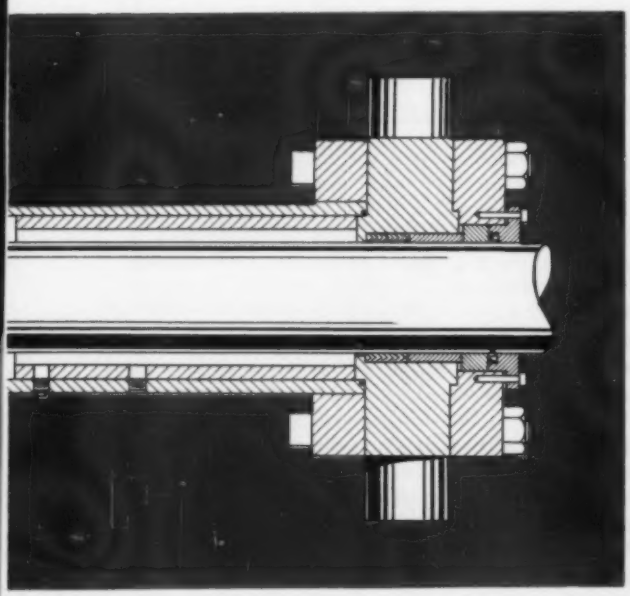
To prevent the piston from dropping in the event of hydraulic line failure, a spring-loaded mechanical latch integral with the cylinder holds the piston retracted until piston downstroke hydraulic pressure overpowers the spring and releases the latch.

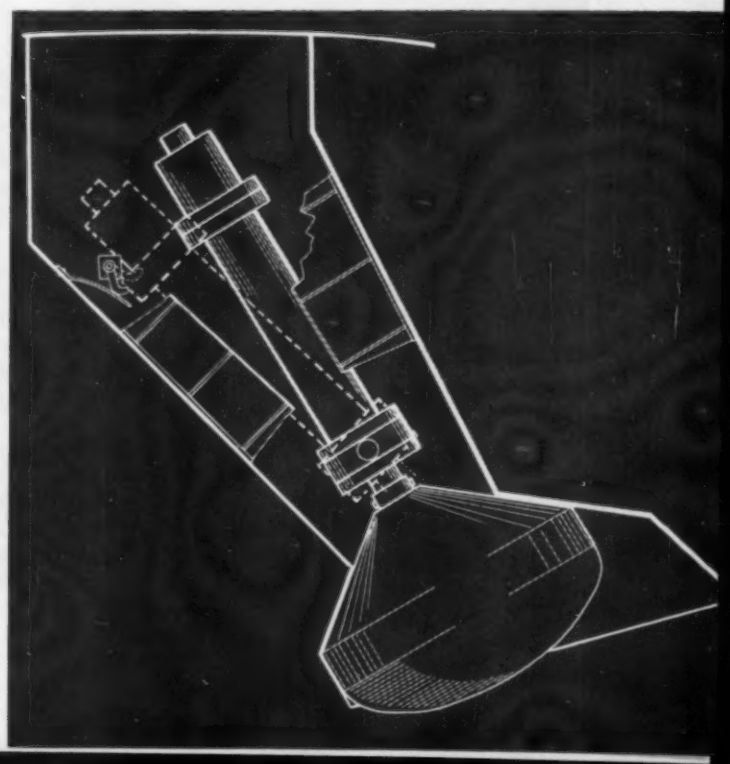
• **Speed control for ramp lowering**—In addition to the debeaching gear, the hydraulic system powers two large cylinders for raising the ship's 110,000 pound beaching ramp. These cylinders mount horizontally on



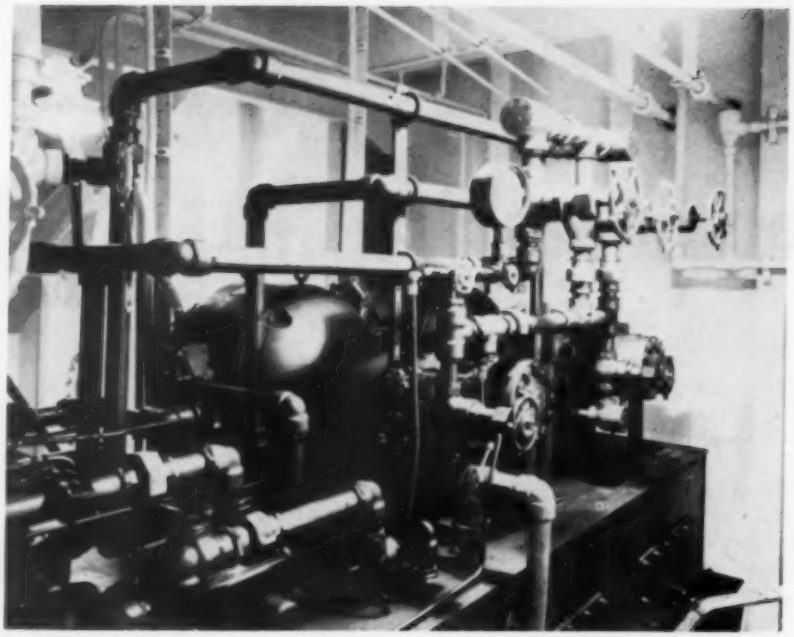
DE-BEACHING RAM retracts when its pilot valve trips at maximum ram swing. The cylinder's latch is released when the head end of the ram is pressurized.

POGO STICK ACTION is achieved when the keel-mounted ram lifts the ship's bow with every stroke. Dragging is prevented by instant reversal when arc limit is reached.



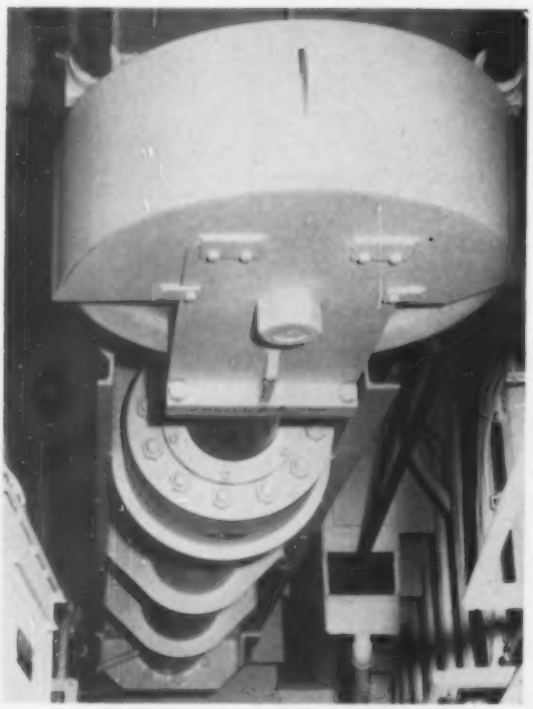


HYDRAULIC POGO STICK



PRIMARY HYDRAULIC POWER is supplied by nearest pump. Duplicate, energy power unit is next to it. Valving from primary to standby circuit is manually controlled.

RAMP RAISING CYLINDERS are in the forecastle companionway. They extend sheaves which carry raising cables.



either side of the ship, and extend pulleys carrying cables that raise the ramp. The ramp lowers by gravity, with its descent speed governed by the setting of a flow control valve. Piston rigidity is maintained by 4 ft. of dead stroke to a 6 ft. 4 inch effective piston stroke.

Hydraulic power for these three huge cylinders is supplied by a compact power package located in the hold, near the de-beaching ram. A two-stage, vane type pump normally delivers at 2000 psi, but can work at 2500 psi for one hour without overheating. For emergency service, a duplicate motor and pump are installed. Electric interlocks assure that only one motor can be operated at a time.

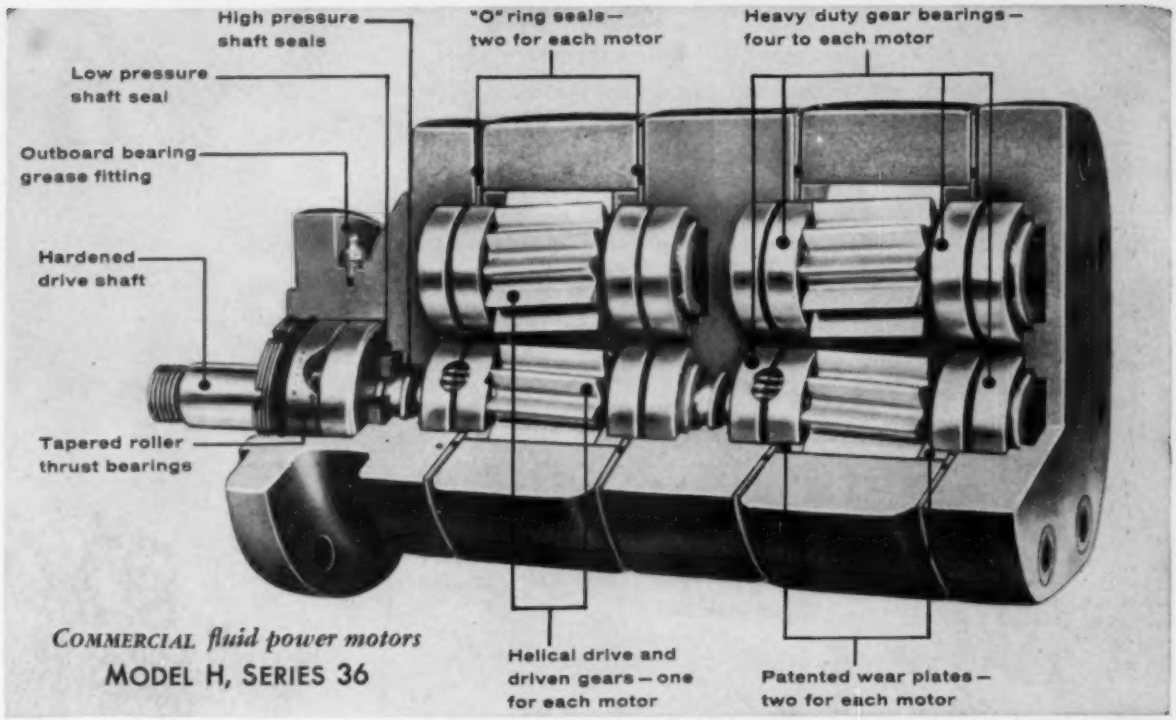
> This Army beach discharge lighter also has an interesting pneumatic control of speed and direction. Air pressure controls its vertical propellers. For details see *Pneumatic Controls for Pitch and Speed* on page 66.

A control pedestal on the ship's forecastle deck is connected through a closed hydraulic system to the valves controlling the de-beaching ram and ramp cylinders.

The hydraulic power unit carries 200 gallons of fluid, supplemented by an 800-gallon storage tank. Fluid can be transferred with a hand pump.

An adjunct to the de-beaching system is a set of variable pitch vertical axis propellers. These are pneumatically controlled. These apply thrust to port or starboard, and ahead or astern and hold the hull steady against tidal swinging forces during the critical back-off operation. They also assist in backing off the beach. ▼▼▼

Technical assistance by WENDELL H. CALKINS, *Chief Naval Architect, National Steel and Shipbuilding Corp., San Diego, California.*


High pressure shaft seals
"O" ring seals—two for each motor
Heavy duty gear bearings—four to each motor
Low pressure shaft seal
Outboard bearing grease fitting
Hardened drive shaft
Tapered roller thrust bearings
COMMERCIAL fluid power motors
MODEL H, SERIES 36
Helical drive and driven gears—one for each motor
Patented wear plates—two for each motor

How to get multiple "speed-torque" output

Multiple-speed drive simplified

Efficient operation of heavy mobile equipment frequently involves multiple speeds. Not so efficient, however, is the shifting of gears, the power take-offs, clutches and gear transmissions involved in gaining these desired speed levels with mechanical drives—not to mention the constant maintenance headaches these same drives entail.

Pictured above is one Commercial fluid power oil-hydraulic motor that now delivers low and high speeds efficiently—completely eliminates the problems mechanical drives ordinarily involve.

Two motors work in tandem

This Commercial Model "H" tandem motor actually involves two single motors of equal output mounted on one common drive shaft. When fluid power from the pump source is directed by simple valving into just one of the single motors, the shaft rotates at the high speed. The other single motor on the same shaft receives no input and therefore merely turns. When low speed is required, the total fluid power delivery from the pump is valved into both of the single motors. And of course motor torque at this reduced speed is doubled. This simplified control of two speeds—both low and high—is possible in either direction, forward or backward.

Each of the single motors in this Model "H" tandem motor has one-inch gears. With a fluid power input of about 15 gpm at 1200 psi, for example, when one of the single motors receives the entire input, rotation is 1200 rpm. When the same input is split between the two equal size single motors, rotation is 600 rpm.

Model "H" motors are available with gears in widths of 1", 1¼", 1½", 2", 2½" and 3". Any combination of gear sizes is practical.

More than two speeds

Even three speed operation can be obtained with Commercial double tandem motors when gears of different widths are used in each single motor. High speed operation results when the full pump delivery is valved to the motor with the smaller gears, intermediate speed when it is all directed to the larger gear motor, and slow speed when valved to both motors. Commercial Model "H" motors are recommended for continuous duty operation at pressures up to 2000 psi and speeds up to 1800 rpm.

Engineering help available

Be sure to send for your copy of Commercial's "Oil-Hydraulic Motors Catalog H-4". Further information on Commercial's complete line of other fluid power components—valves, pumps and cylinders—is also yours for the asking, as is help and assistance from COMMERCIAL's technical service department.

Address inquiries to Commercial Shearing & Stamping Company, Dept. A-6, Youngstown 1, Ohio.

COMMERCIAL
shearing & stamping

This marine hydraulic steering system features:

- *Only two steel or copper tubes to connect the helm to the steering gear.—No cables or sheaves.*
- *Vented hydraulic system.—No serious troubles from minor leakage, as with closed systems.*
- *Emergency steering built into the power system at low additional cost, using standard components.*
- *Efficient power transmission through a telemotor cylinder, to the steering ram.*

Designing a marine steering system with emergency control

• By **LEIGHTON W. JOHNSON,** *Chief Engineer*
Gunderson Bros. Engineering Corp., Portland, Oregon

MANUAL steering is required on all commercial vessels as an emergency auxiliary. We have developed a steering gear hydraulic circuit that provides both power and manual operation. A conventional steering wheel drives a hydraulic pump which actuates a telemotor cylinder. The telemotor piston rod is linked to a 4-way follower valve which directs fluid to the steering rams from a conventional hydraulic power package.

By shifting two manually-operated, 3-way valves, the entire power steering system is bypassed, and fluid from the steering wheel pump goes directly to the steering rams, in response to the helmsman's wheel.

Manual Steering System

• **Sizing the steering ram**—These were design parameters for the manual steering system:

Maximum rudder torque = 80,000 in.-lb.
Tiller arm = 16 in.
Rudder Swing = 35 degrees right and left
Rudder Speed = 1 degree/sec.

Referring to the vector diagram, ram force required for maximum rudder torque (at the 35 degree position) is:

$$\text{Maximum ram force} = \frac{80{,}000 \text{ in.-lb.}}{16 \text{ in. (cos 35)}} = 6097 \text{ lb}$$

Selecting a maximum working pressure of 600 psi, we determined the area of the ram.

$$\text{Ram Area} = \frac{\text{Force}}{\text{Pressure}}$$

$$\frac{6097 \text{ lb.}}{600 \text{ psi}} = 10.2 \text{ sq. in.}$$

This would mean a ram diameter of 3.6 inches. A standard 4-in. diameter ram has an area of 12.57 sq. in. Using this size and recomputing working pressure:

$$\frac{6097 \text{ lb.}}{12.57 \text{ sq. in.}} = 484 \text{ psi}$$

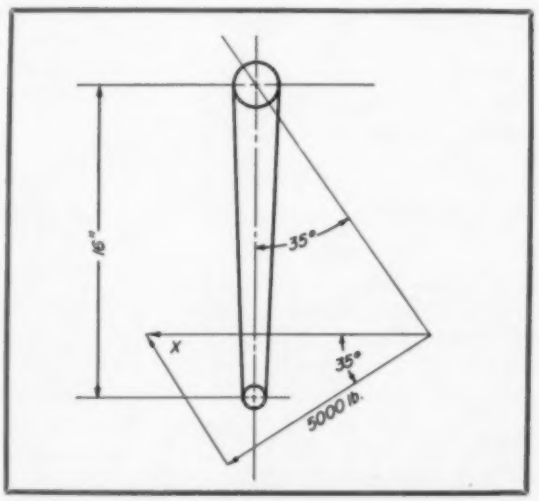
• **Helm-operated hydraulic pump**—Total ram stroke required from 35 degrees left rudder to 35 degrees right rudder is:

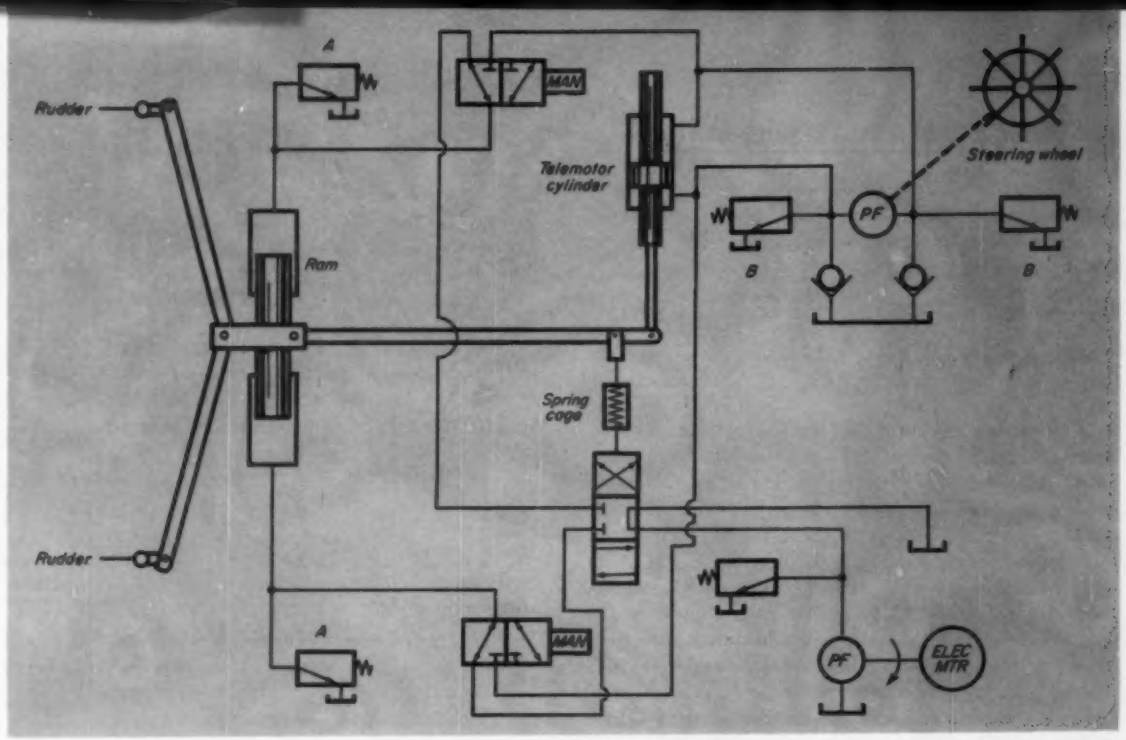
2 (16 in. x sin 35) = 18.35 in.

Oil volume to move the ram through its full 70 degrees traverse is:

Volume = Ram area x Ram stroke
= 12.57 sq. in. x 18.35 in. = 237 cu. in.

A pump was selected, having a displacement of 1.50 cu. in/rev.





RELIEF VALVES A are set 10 to 15% higher than system pressure to limit pressure due to thermal expansion of oil, and allow for rudder movement by outside forces, such as the rudder striking a floating log. B valves merely allow for thermal oil expansion.

The number of pump revolutions for full rudder traverse is:

$$\text{Pump revolutions} = \frac{\text{Total oil volume}}{\text{Pump displacement}} = \frac{237 \text{ cu. in.}}{1.50 \text{ cu. in./rev.}} = 158 \text{ rev.}$$

Under manual operation, the rudder must swing through its entire arc in 70 seconds. Pump delivery is:

$$\text{Delivery} = \frac{\text{Total oil volume}}{\text{Traverse Time}} = \frac{237 \text{ cu. in.} \times 60 \text{ sec./min.}}{70 \text{ sec.} \times 231 \text{ cu. in./gal.}} = .88 \text{ gpm}$$

Pump speed to move the rudder at the emergency speed of 1 degree/sec. is:

$$\text{Pump Speed} = \frac{\text{Pump Revolutions}}{\text{Operating Time}} = \frac{1.58 \text{ rev.} \times 60 \text{ sec./min.}}{70 \text{ sec.}} = 135.6 \text{ rpm}$$

• **Mechanical advantage to the helm**—Torque to rotate the pump is:

$$\text{Torque} = \frac{\text{Radius} \times \text{Pump Power}}{2\pi \times \text{Pump Speed}}$$

Pump output power is:

$$\text{Power (hp)} = \text{Delivery (gpm)} \times \text{Pressure (psi)} \times .00583$$
$$= .88 \text{ gpm} \times 484 \text{ psi} \times .00583 = .248 \text{ hp}$$

Pump efficiency is 90%, so torque is:

$$\text{Torque} = \frac{396{,}000 \text{ in-lb/min./hp} \times .248 \text{ hp}}{135.6 \text{ rpm} \times .90 \times 2\pi} = 128.3 \text{ in.-lb.}$$

To calculate the mechanical ratio needed between the helmsman's wheel and pump, we allowed 10% for efficiency losses through the drive.

$$\text{Mechanical Ratio} = \frac{\text{Pump Delivery}}{\text{Number of Helm Turns} \times \text{Pump Displacement}}$$

We selected 15 helm turns as a reasonable number for rotating the rudder through its arc.

$$\text{Ratio} = \frac{231 \text{ cu. in./gal} \times .88 \text{ gpm}}{15 \times 1.50 \text{ cu. in./rev.}} = 9.04$$

We used a 9:1 ratio.

Allowing 10% for drive losses, steering wheel pull for maximum torque is:

$$\text{Wheel pull} = \frac{\text{Torque} \times \text{Gear Ratio} \times 1.10}{\text{Steering Wheel Radius}} = \frac{128.3 \text{ in.-lb.} \times 9 \times 1.10}{28 \text{ in.}} = 45.4 \text{ lb.}$$

Power Steering System

• **Sizing the power pump**—Components for the steering system are sized similarly. Rudder speed for this system is 5 degrees/sec. This would mean a total traverse time of 14 seconds for the full 70-degree rudder arc. Allowing 1 second time loss through the telemotor system, 13 seconds is the actual time. Pump delivery to move the rudder with the hydraulic power system is:

$$\text{Delivery} = \frac{\text{Oil volume}}{\text{Traverse time}} = \frac{237 \text{ cu. in.} \times 60 \text{ sec./min.}}{13 \text{ sec.} \times 231 \text{ cu. in./gal.}} = 4.74 \text{ gpm}$$

To allow for leakage losses, we used 5 gpm.

To calculate horsepower of the electric motor to drive the hydraulic pump, we assumed a 90% efficiency factor:

$$\text{Power (hp)} = \frac{484 \text{ psi} \times 5 \text{ gpm} \times .00583}{.90} = 1.57 \text{ hp}$$

We selected a pump that delivers 5 gpm at 500 psi, driven by a 2-hp electric motor.

• **Telemotor cylinder design**—The telemotor cylinder's stroke is governed by position of the follower valve. Although the follow-up lever diagram shows a geometric relationship, the follower valve shifting distance must be added to the telemeter cylinder stroke, because the ram crosshead may be near the end of its travel with insufficient cylinder stroke to complete the valve spool shift. The spring cage shown on the follow-up diagram, absorbs any additional movement of the telemotor piston after the follower valve has opened, and prior to movement of the cross head.

Having determined ram stroke (for 35 degrees) of 9.18 in., we can assume that the x distance on the diagram is 15 in. and y distance is 3 in. Telemotor cylinder stroke is:

$$\text{Telemeter cylinder stroke} = \text{Ram Stroke}\left(\frac{y}{x}\right)$$

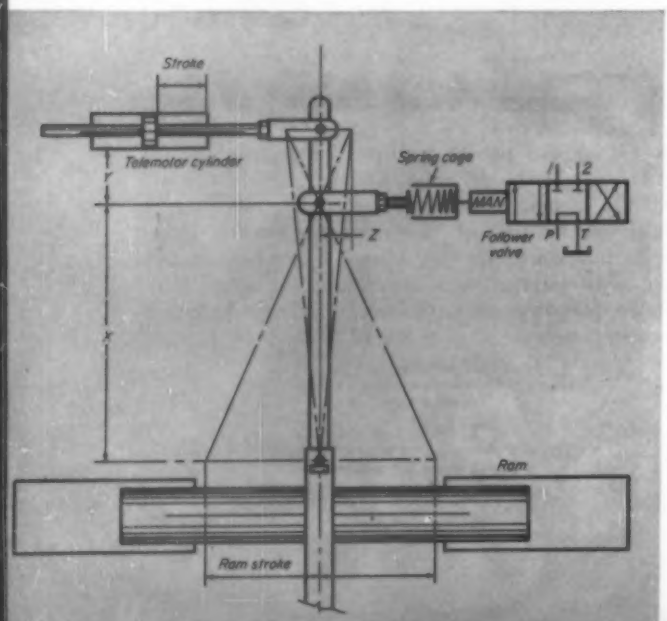
$$= 9.18 \text{ in.}\left(\frac{3 \text{ in.}}{5 \text{ in.}}\right) = 1.83 \text{ in.}$$

Adding .250 inch for follower valve shifting, total telemotor cylinder stroke is 2.08 in. We used 2.25 in.

To determine valve actuator shifting distance for 35° rudder travel (follower valve stroke plus spring compression length)

$$Z = \text{Telemotor cylinder stroke}\left(\frac{x}{x+y}\right)$$

3-PIVOT BEAM linking telemotor cylinder, directional valve and rudder ram forms position servo system to close valve when ram reaches position corresponding to telemotor position.



$$= \frac{2.25 \text{ in.} \times 15 \text{ in.}}{18 \text{ in.}} = 1.87 \text{ in.}$$

No more than four full turns of the steering wheel should furnish full 70-degree rudder travel during power steering. To size the telemotor cylinder, its volume is:

$$\text{Cylinder Volume} = \text{Number of wheel turns} \times \text{gear ratio} \times \text{displacement}$$

$$= 4 \times 9 \times 1.5 \text{ cu. in} = 54 \text{ cu. in.}$$

The cylinder stroke for 35 degree rudder travel is 2.25 in., so for 70-degree stroke it is 4.5 in.

Effective area of the telemotor cylinder is:

$$\text{Effective Area} = \frac{\text{Volume}}{\text{Stroke}}$$

$$= \frac{54 \text{ cu. in.}}{4.5 \text{ in.}} = 12 \text{ sq. in.}$$

If we use a 1-in. diameter piston rod, actual cylinder bore area is:

$$\text{Actual Area} = \text{Effective Area} + \text{Piston Rod Area}$$

$$= 12 \text{ sq. in.} + .78 \text{ sq. in.} = 12.78 \text{ sq. in.}$$

Computing telemotor cylinder diameter

$$\text{Diameter} = 1.128 \times \text{Area}$$

$$= 1.128 \times 12.78 \text{ sq. in.}$$

$$= 4 \text{ in. (approx)}$$

A telemotor cylinder with a 1-in. diameter, double end piston rod, 4-in. bore and 4½-in. stroke meets power system design requirements.

• **Pressure drop and wheel pull**—To allow for cold weather operation, we checked pressure drop through the lines, using 100 ft. of ½-in. O. D. tubing with .035-in. wall at 40°F minimum temperature. Flow is laminar.

$$\text{Pressure Drop} = \frac{.000668 \text{ ULs}}{d^3}$$

U = Absolute viscosity at 40 F = 196 SSU
L = Length of tubing (ft.)
s = Fluid velocity in ft./sec.
d = I. D. of tubing, in.

To determine fluid velocity

$$\text{Flow rate} = \frac{\text{Cylinder Volume}}{\text{Stroke Time}}$$

$$= \frac{54 \text{ cu. in.} \times 60 \text{ sec./min.}}{13 \text{ sec.} \times 231 \text{ cu. in/gal.}} = 1.08 \text{ gpm}$$

$$\text{Fluid velocity} = \frac{\text{Flow rate}}{\text{Internal area of tube}}$$

$$= \frac{1.08 \text{ gpm} \times 231 \text{ cu. in./gal.}}{60 \text{ sec./min.} \times .15 \text{ sq. in.} \times 12 \text{ in./ft.}} = 2.30 \text{ ft/sec}$$

$$= 2.30 \text{ ft./sec.}$$

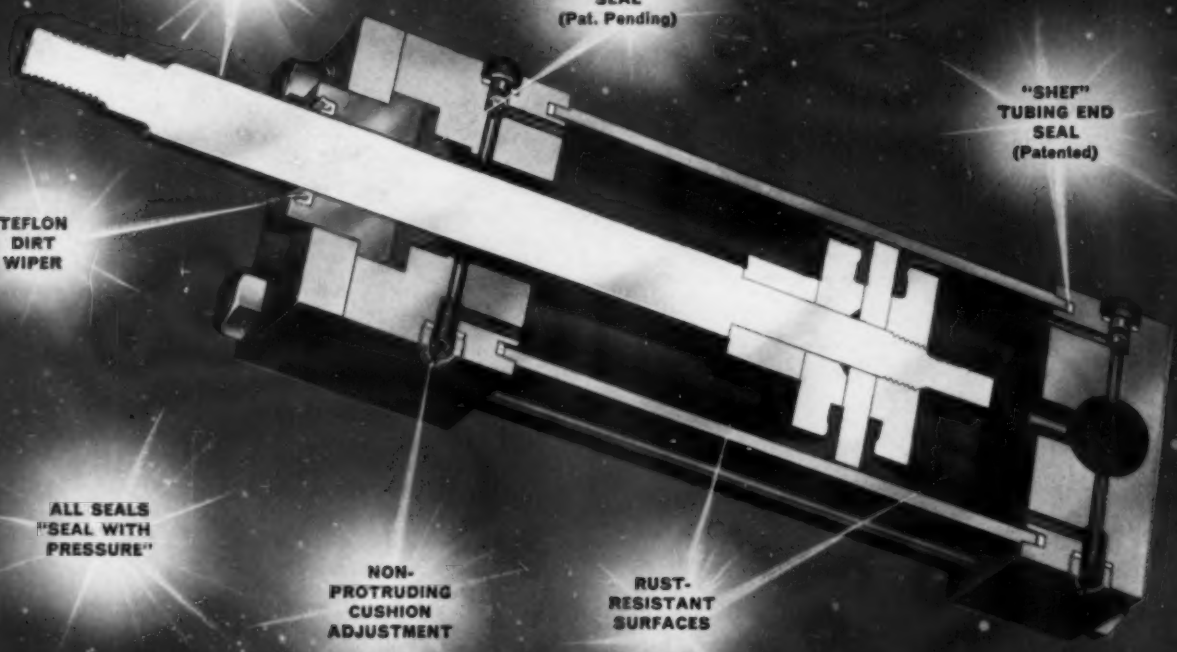
Substituting these values and using 100 ft. of tubing:

$$\text{Pressure Drop} = \frac{.000668 \times 196 \text{ SSU} \times 100 \text{ ft} \times 2.3 \text{ ft./sec.}}{(.43)^3 \text{ inches}}$$

$$= 163 \text{ psi at 40 F}$$

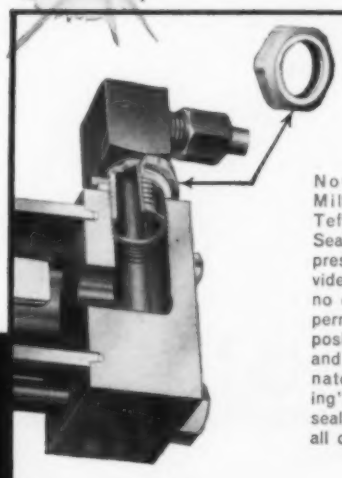
Concluded on page 84

Stellar RELIABILITY and ECONOMY


CASE HARDENED CHROME-PLATED ROD
"STA-DYN" ROD FLANGE SEAL (Pat. Pending)
"SHEF" TUBING END SEAL (Patented)
TEFLON DIRT WIPER
ALL SEALS "SEAL WITH PRESSURE"
NON-PROTRUDING CUSHION ADJUSTMENT
RUST-RESISTANT SURFACES

Miller AIR CYLINDERS

PORT SEALS



Now—with every Miller Cylinder—Teflon-sealed Port Seals that "Seal with pressure" are provided as standard at no extra cost. They permit much faster positioning of lines and fittings, eliminate "overtightening" damage, and seal perfectly against all operating media.

Here are eight more reasons why Miller Air Cylinders continue to be the most economical and reliable cylinders that money can buy. These stellar features—including the new port seals—are standard Miller construction—yours at no extra cost. Thus, they provide appreciable savings in original investment—*particularly for those who insist on "J. I. C." quality throughout.* Savings in operating costs are even greater, because these features are proven assurance of longer cylinder life, greater efficiency, reduced maintenance and downtime.

Specify "Miller" for greater reliability and economy! Write for bulletin.

R

MILLER FLUID POWER

7N017 York Road, Bensenville, Illinois

Rigid servo system powers high frequency wavemaker

• By **F. B. LEVETUS,** *Technical Director, Keelavite Hydraulics Ltd., Allesley, England*

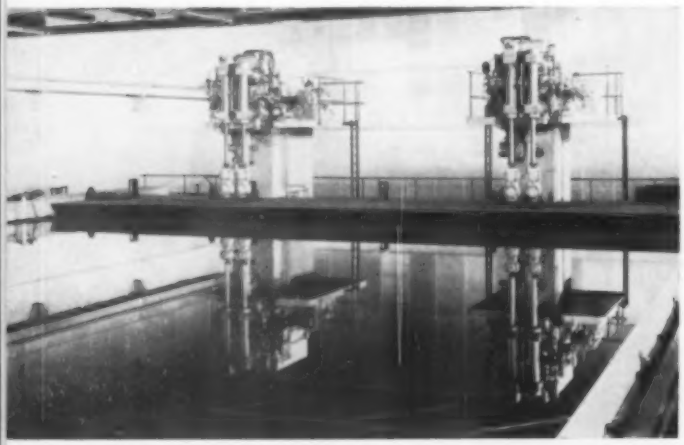
It takes a stiff hydraulic system to vibrate a 20-ton plunger at 1 cps. To get this response, the natural frequency of this system was raised to 10 cps.

A FAST response, electrohydraulic servo system generates 2-ft waves in the towing tank at Britain's National Physics Laboratory. The tank tests stability of ship models up to 40 ft long.

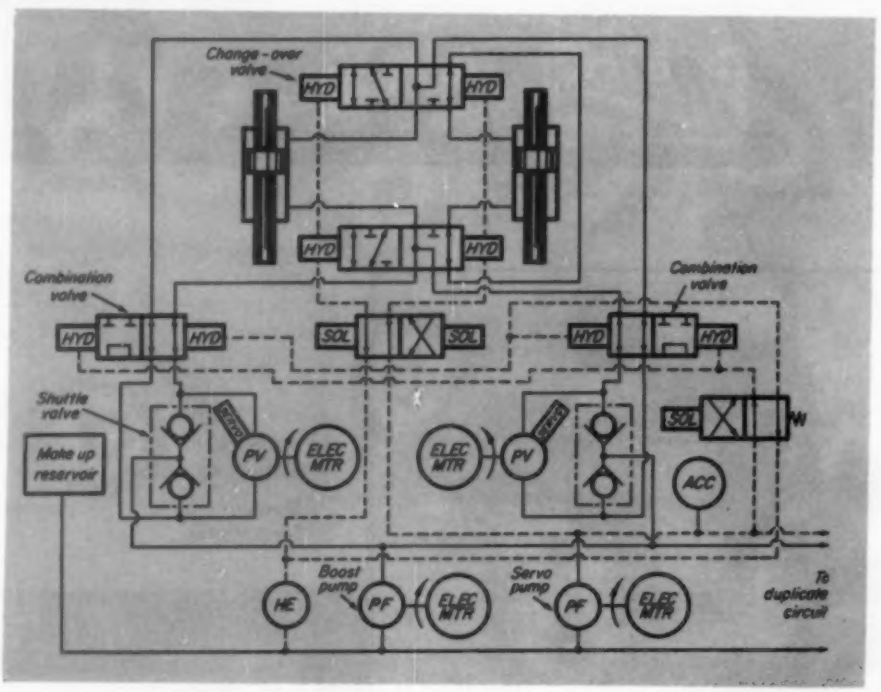
Two pairs of servo-controlled hydraulic cylinders move a 20-ton, wedge-shaped plunger up and down to displace water and create a uniform train of waves. Wave frequency varies directly with plunger frequency. Wave height varies directly with plunger amplitude.

• **Plunger buoyancy**—To get the speed and accuracy required in the system, external forces acting against movement were reduced to a minimum. One of these forces was the buoyancy of the hollow steel plunger. The first plan was to ballast the plunger with water, but this would add to the mass and make its control more difficult. The final design uses two single-acting air cylinders supplying enough force to offset the buoyancy.

• **Natural frequency**—Every servo system has its own natural frequency. This frequency determines the maximum cycling of the system. The higher the natural



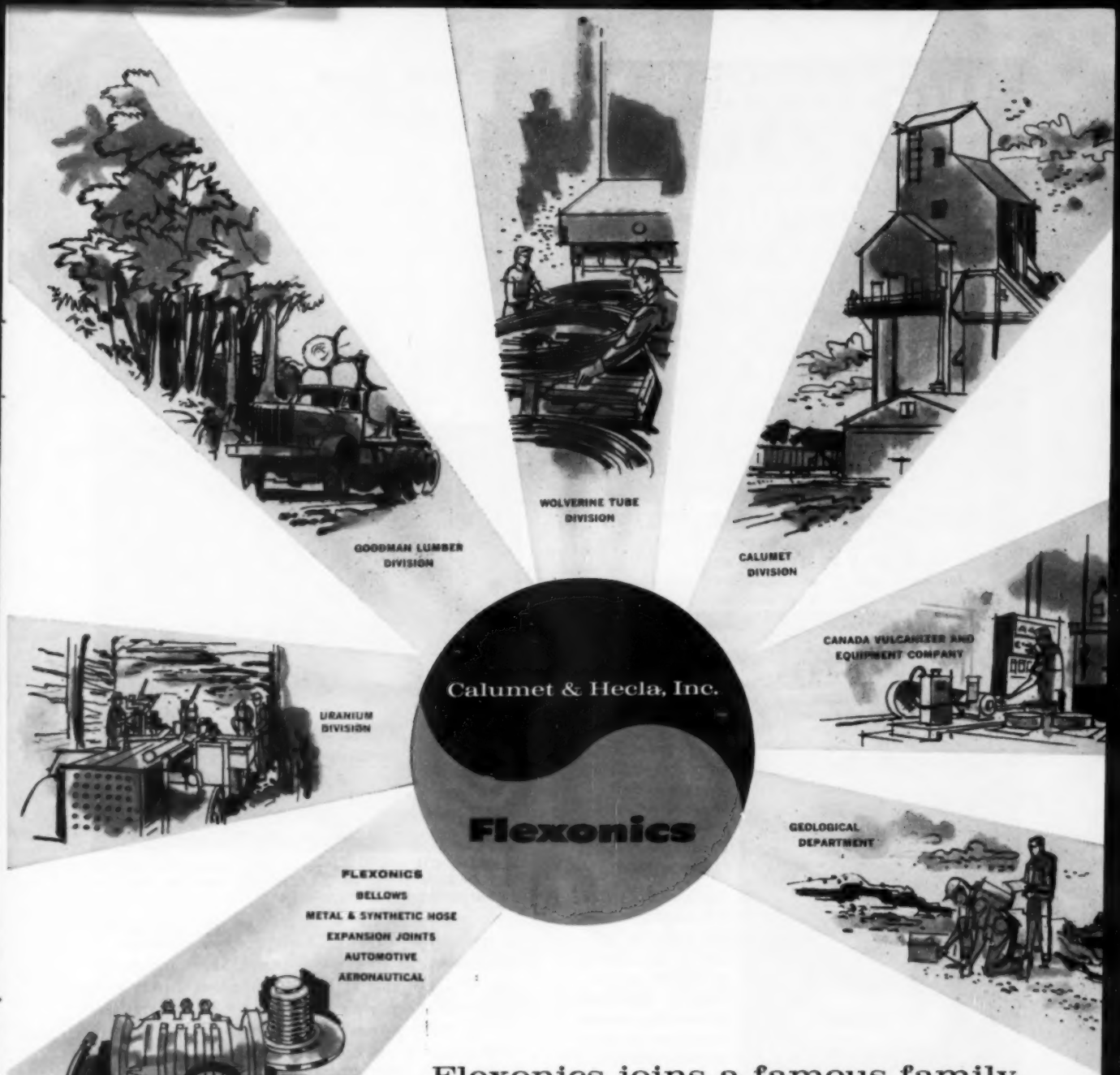
FOUR, SERVO-CONTROLLED, HYDRAULIC CYLINDERS oscillate a plunger to generate waves in this ship model testing tank.



TWO SERVO-CONTROLLED, TWO-WAY PUMPS oscillate the cylinders attached to each side of the wave making plunger. An electrical interlock in the servo circuit synchronizes the two circuits. With the change-over valves in the position shown, output from both pumps is directed to one cylinder. When the valves shift, each pump supplies a separate cylinder.

The shuttle valves direct booster pump output to either port on the main pump, depending on direction of flow through the pump. A combination valve in each pump's delivery line stops the plunger quickly. It cuts off oil flow from the pump to the cylinder and also bypasses the pump.

Circle 45 →



Flexonics joins a famous family

. . . to bring you better products and services

Flexonics Corporation's new affiliation with Calumet & Hecla, Inc., marks another important forward step.

Over its fifty-year history, Flexonics has become a major factor in the precision forming of thin metals—in the manufacture of metal hose, metallic bellows, expansion joints, hydraulic hose assemblies, automotive parts, aircraft and missile ducting systems—virtually everything for combined motion and fluid flow.

Calumet & Hecla now brings its broad industrial base to Flexonics technology. To industry, this means that new research and development facilities, new production capabilities, will soon be bringing you even better Flexonics products, an even wider range of Flexonics services.

The entire Flexonics organization is looking forward to serving you better . . . in more ways.

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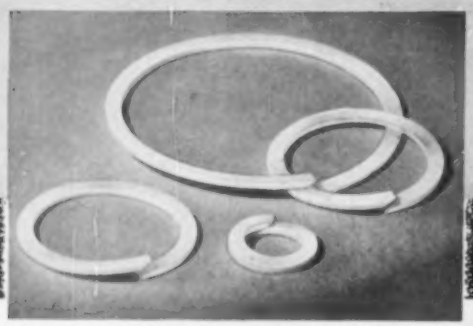

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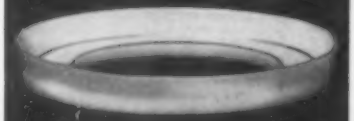
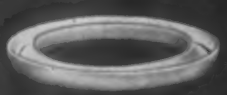
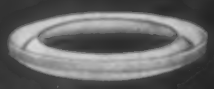


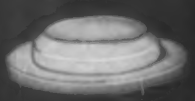
Style 310 Piston Cups



Style 614 V Rings



Style 410 U Cups and Blocked Vees



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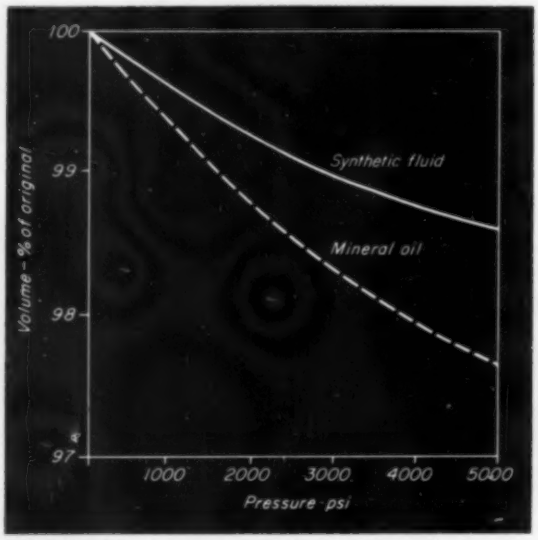
Circle 58 on Time-Saver Card

RIGID SERVO SYSTEM

frequency, the higher the speed at which control is possible, and the greater the degree of control at low speeds.

• **Fluid compressibility**—Fluid elasticity in long hydraulic cylinders reduces natural frequency. To decrease elasticity, a synthetic hydraulic fluid is used in this system. Compressibility is about one half that of mineral oils.

Natural frequency also depends on the quantity of fluid in the system. To keep the amount of fluid as low as possible, a closed hydraulic system is used. All components are designed to hold a minimum of fluid. Valves and pumps are mounted near the cylinders to eliminate long pipe runs.



MINERAL OIL compresses considerably more under pressure than synthetic fluids. Fluid compression must be kept low for fast cycling of a heavy load.

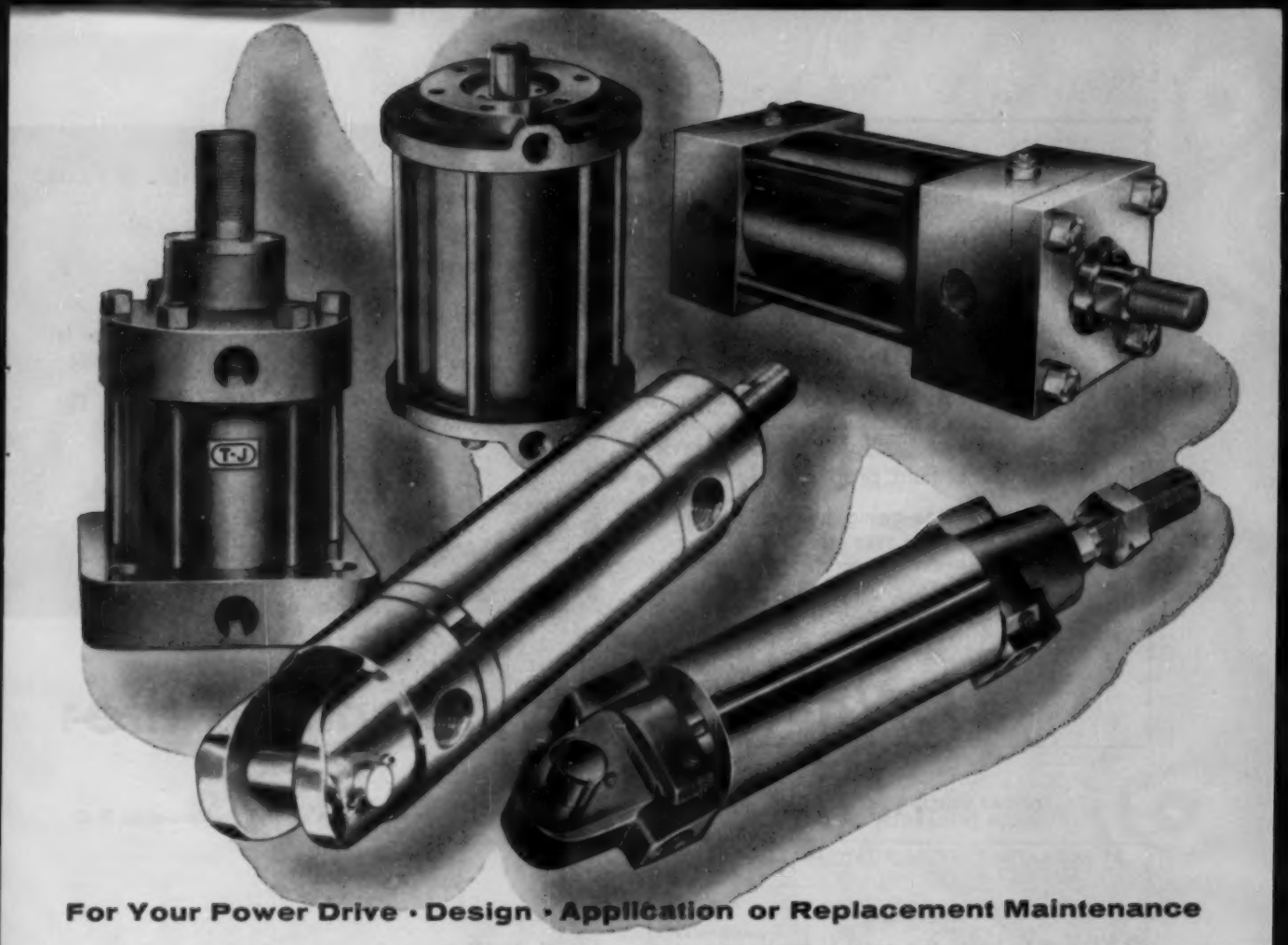
• **Hydraulic Circuit**—Each of four cylinders is powered by its own 2-way pump. These pumps deliver 0 to 110 gpm at 1800 psi in either direction. A booster pump supplies oil to the main pumps at 250 psi. A make-up reservoir replaces fluid lost through leaks.

Two-stage, electrohydraulic, servo valves mount on each pump and control the direction and quantity of fluid pumped. The servo valves position a cylinder connected to the swashplate on the axial piston pumps.

The wavemaker requires maximum cylinder stroke and velocity at minimum frequency; and reduced cylinder stroke and velocity at maximum frequency. By using both cylinders connected to individual pumps for high frequency, the natural frequency of the system is increased when it is most needed. By directing the flow of both pumps to one cylinder during low frequency operation, higher velocity is obtained without additional pumps. The lower natural frequency is not critical under these conditions.

Cylinder frequency and amplitude are selected by positioning dials connected to potentiometers at the servo control console. ▼▼▼

Circle 114 →



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THE TOMKINS • JOHNSON CO. JACKSON, MICH.

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Toxic effects of hydraulic fluids can be disastrous aboard a nuclear submarine which is under water for weeks at a time. The Navy is constantly checking toxicity, fire-resistance, shear stability, and other fluid properties to improve its sea-going hydraulic systems.

IDEAL SHIPBOARD HYDRAULIC FLUID

- *Non-toxic in enclosed areas for long periods.*
- *Viscosity index of 150 ± 25, based on 100 F and 210 F viscosities.*
- *Shear stability not to exceed 5% decrease in viscosity.*
- *Maximum viscosity, 4000 SSU at 25 F, and 120—145 SSU at 150 F.*
- *Chemical and thermal stability at 350 F.*
- *Hydrolytic stability in sea water.*
- *Non-foaming.*

What the navy wants in fire-

• By H. F. KING and CDR. J. A. COIL, *USN, Bureau of Ships, Department of the Navy, Washington, D. C.*

ONE way to insure that naval hydraulic equipment works efficiently and reliably, is to start with the fluid. Constant testing of hydraulic fluid properties is aimed at better performance.

Fluid toxicity is a hazard on nuclear submarines, where crews are in confined quarters for long periods of time. Hydraulic fluids must not form toxic vapors which contaminate the ship's atmosphere. All naval vessels have the fire-resistance requirement for combat conditions. Phosphate ester fire-resistant fluids which are being used are low in viscosity index and need an additive to improve them. Unfortunately, when the polymeric improver is added, there is a loss of viscosity and shear stability over a period of time.

Fluid is subject to shear from the dimensional clearances of some of the components, such as pumps and solenoid valves. Laboratory tests show that phosphate ester fluids are generally best for Navy purposes, even though they have some shortcomings.

• **What's Safe?**—Phosphate ester fluids have been tested to determine safe vapor concentration in closed quarters. The Bureau of Medicine and Surgery has established 0.6, 0.3, and 0.06 ppm as safe maximums for periods of 30, 60, and 90 days, respectively. Fluids dripping on a hot surface can generate clouds of suspended fluid particles, when surface temperature exceeds 150 F. To simulate this in the laboratory, the surface is kept at 250 F. After the vapor source is removed, fluid particles fall rapidly. Petroleum base fluids produce a smoke which remains suspended until removed by air-purification equipment.

• **Fire resistance**—Compression ignition can occur when a high pressure air valve is opened into a dead-end section of shipboard piping, when fluid is adhering to the pipe wall. Among fluids tested for compression ignition, all but water base and phosphate ester were eliminated. Mineral oils ignite at compression ratios of less than 20:1. Phosphate esters remain stable to about 40:1. From these tests, we concluded that:

1. Ignition by pressure waves and flame travel in wetted lines does occur.
2. Flame fronts travel at velocities of 100 to 140 ft./sec.
3. Explosive forces can damage system equipment.
4. Factors influencing compression ignition are fluid ignitability, release pressure, and rate and magnitude of pressure rise.
5. Phosphate esters have relatively good flame resistant qualities.

A modified CFR compression ignition engine was used to verify pipe test results. These results are shown

SHOULD HAVE THESE PROPERTIES:

- *Low compressibility.*
- *Low volatility.*
- *No objectionable odor.*
- *Non-corrosive to steel, copper, and bronze.*
- *Suitable for a lubricant in high pressure air compressors, screw, piston, and vane type pumps.*
- *Compatible with at least one commercially available packing material.*
- *Non-slick-forming in sea water.*

resistant fluids

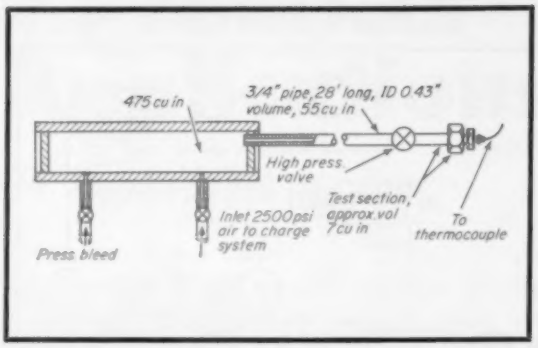
in Table II. Autogenous ignition, spray flammability, flash and fire, and self-extinguishing properties of the phosphate esters proved superior to other fluids tested.

- **Chemical stability**—Phosphate esters are subject to hydrolisis, with resultant corrosive effects. Studies proved that the hydrolytic stability of the fluid can be improved if the purity of the organic acids before esterification is controlled. Suppliers attention to acid purity has produced fluids so stable that specifications now limit the acid number to 0.2 milligrams of potasium hydroxide per gram of fluid.

- **Viscosity stability**—Under normal operating conditions, phosphate ester fluids show satisfactory viscosity under shear. When pumped through 5000 cycles at 1000 ± 50 psi with a pump inlet temperature of 100 F, there is no loss of viscosity. When a polymer-thickened phosphate ester is subjected to high shear rates, there is an irreversible viscosity decrease. There is also a progressive, irreversible decrease in the fluid's viscosity index. This causes two problems:

1. Screw type hydraulic pumps need at least a medium viscosity oil for proper lubrication. The thickener tends to shear under the stresses imposed by these pumps.
2. Products of decomposition from shear may be highly flammable, noxious, or even toxic.

Concluded on next page


475 cu in
3/4" pipe, 28' long, ID 0.43"
volume, 55 cu in
High press. valve
Test section, approx vol 7 cu in
To thermocouple
Inlet 2500 psi air to charge system
Press bleed

PIPE TEST RIG for compression-ignition tests. Ignition is indicated when the pipe temperature rises above that of a dry run, where the pipe wall is not wetted.

TABLE I
PIPE TEST (3000 psi)

TYPE OF FLUID	NO. TRIALS	FIRED AT 80 F.	NO. TRIALS	FIRED AT 140 F.	NO. TRIALS	FIRED AT 200 F.
Petroleum Oil	242	222	1	1	0	0
Water Base	10	0	6	0	15	5
Phosphate Ester	3	0	0	0	3	0

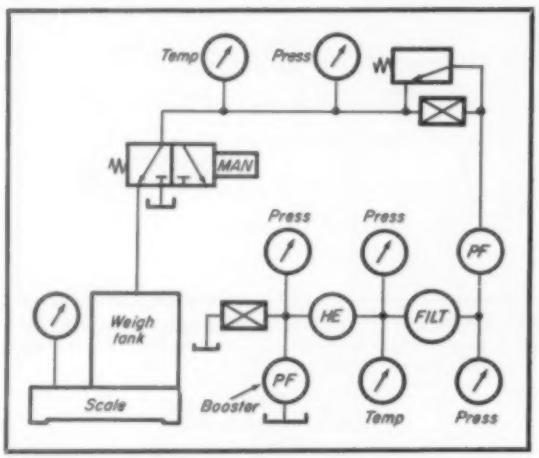
TABLE II
COMPRESSION-IGNITION RATIOS FOR VARIOUS HYDRAULIC FLUIDS

	WATER JACKET TEMPERATURE °F						
	80	100	120	140	160	180	212
Petroleum	19						13
Water-Glycerol	55			51	47	44	42
Water-Glycerine	55						54
Glycerine	55						55
Phosphate Ester	47	50	48	40	40	40	45
Chlorinated HC + Ester	48	42	42	44	42	40	40
Chlorinated HC	48	37	42	39	45	41	34
Oil-Water emulsion	26						21
Fluorinated & Cl-HC	55						

TABLE III
EFFECT OF 3000 psi SHEAR STRESS ON A POLYMER THICKENED PHOSPHATE ESTER

TEST TIME	VISCOSITY SSU 100 F.	210 F.	VISCOSITY-CS 25 F.
Start	625	66.7	12,000
2 hours	582	63.9	.....
200 hours	432	54.2	.....
300 hours	.....	.....	8640
400 hours	417	53.1	.....

WHAT THE NAVY WANTS IN F-R FLUIDS



FLUID LUBRICITY TEST CIRCUIT. Pressure and temperature probes located at key spots in the system indicate where and when shear and friction occur. Increase in temperature indicates friction. Pressure differential indicates shear.

• **Lubrication**—Hydraulic systems use two types of lubrication. One is sliding (or rubbing), the other, rolling contact. Ball bearings are the primary parts needing lubrication. Bench tests were set up with the ball bearing installed on a spindle. A thrust load was applied at various speeds and cycles to find the time needed to lubricate the bearing with hydraulic fluid. When a piston pump was tested, it failed at the angular ball bearing resisting rotational thrust.

To get more pertinent data, tests were made to find the effects of fire-resistant fluids on life of angular contact ball bearings. The best fluid, a phosphate ester, reduced bearing life to about 30% of that obtained with a petroleum base fluid. Shipboard tests verified these results. Pumps with screw type rotors have large sliding contact areas and high pressures, so that higher viscosity fluids are needed to withstand shear. ▼▼▼

DESIGNING A MARINE STEERING SYSTEM

Concluded from page 76

Since pressure drop exceeds 100 psi, wheel pull must be rechecked:

$$\text{Steering Wheel Pull} = \frac{\text{Torque} \times \text{Gear Ratio} \times 1.10}{\text{Wheel Radius}}$$

$$\text{Torque} = \frac{63025 \times 1.08 \text{ gpm} \times 170 \text{ psi} \times .00058}{167 \text{ rpm} \times .90} = 45.2 \text{ lb.-in.}$$

170 psi includes effort to overcome losses.
167 rpm is pump speed

$$\text{Steering Wheel Pull} = \frac{45.2 \text{ lb.-in.} \times 9 \times 1.10}{28 \text{ in.}} = 16 \text{ lb.}$$

Sixteen pounds of pull on the wheel is acceptable in cold weather operation. ▼▼▼

HIGH QUALITY AT LOW COST!

- 3000 PSI
- −65° to 450°F
- FORGED BODIES
- BRASS AND STAINLESS STEEL
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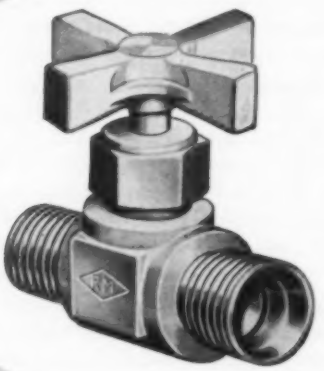

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Reliable, economical general-purpose needle valve. Designed for low cost, but built to Republic's high standard. Easy and economical to install and maintain. Ideal for instrumentation, gage shut-off, test stands, and many other applications. Get Bulletin 959 for complete data.

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Quality controls include 100% continuous Ultrasonic Inspection in addition to four other checks on the weld to assure dependability.

Made from carbon steel, electric-resistance-welded, and cold drawn. Sizes from ½ inch to 3⅞ inches outside diameter, and depending on specific outside diameter, wall thicknesses from .028 to .187 inch.

Seamless Mechanical Tubing for Cylinders

Used generally for the manufacture of high-pressure, heavy-wall cylinders. Supplied cold-drawn or roto-rocked, with surfaces ready for the final finishing operations needed for cylinders of this type. Available in B&W's full line of carbon, alloy and stainless steels. Sizes up to 9¼ inches outside diameter in a wide range of wall thicknesses.

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The dimensional accuracy of B&W Seamless Welding Fittings and Forged Steel Flanges is the key to economical pre-fabrication and installation of process piping. They are available in a complete range of types in a full size range, in carbon steel and the B&W Croloys (alloy and stainless steels).

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- Returns
- Reducers
- Tees
- Caps
- Stub Ends
- Flanges
- Saddles
- Laterals
- Bull Plugs
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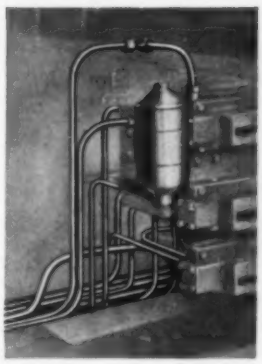

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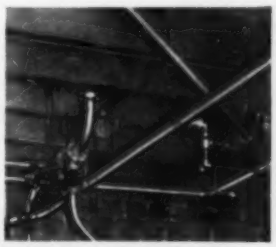
Pressure Piping



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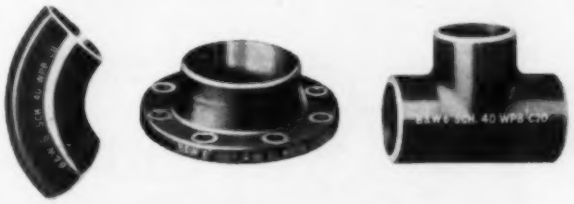

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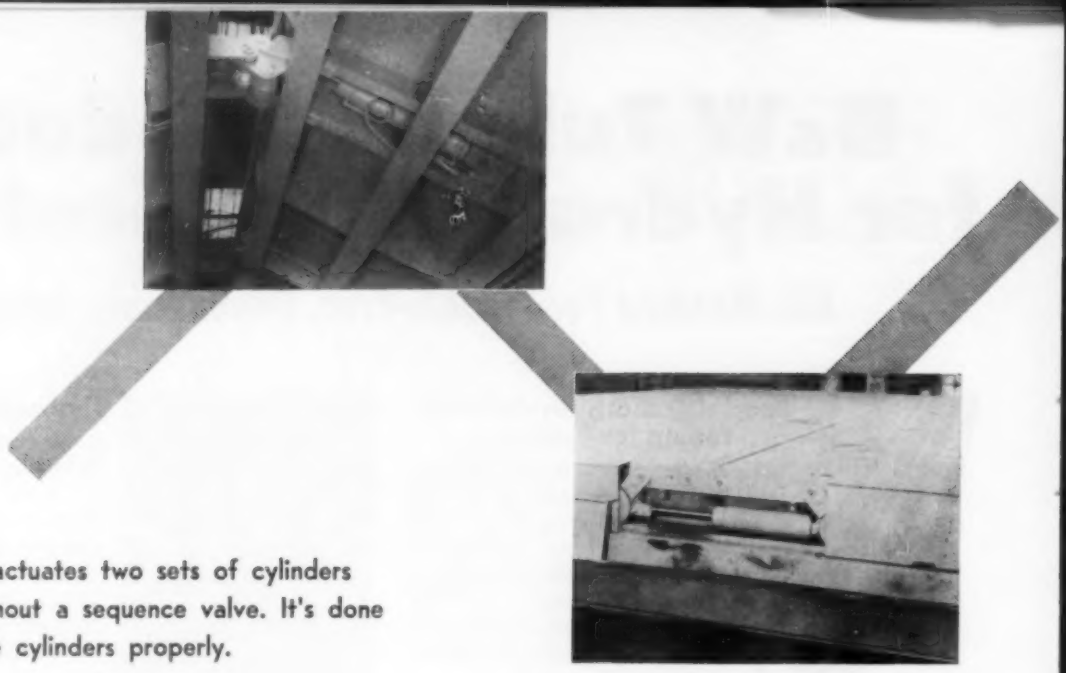
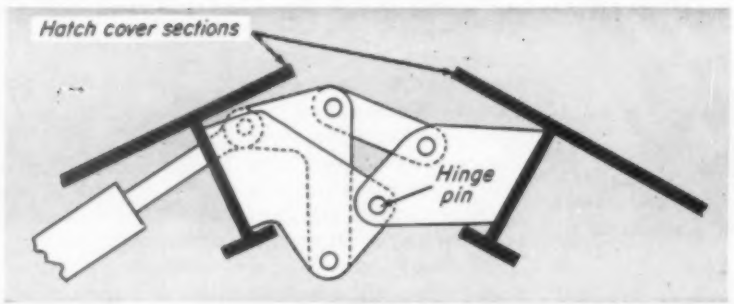
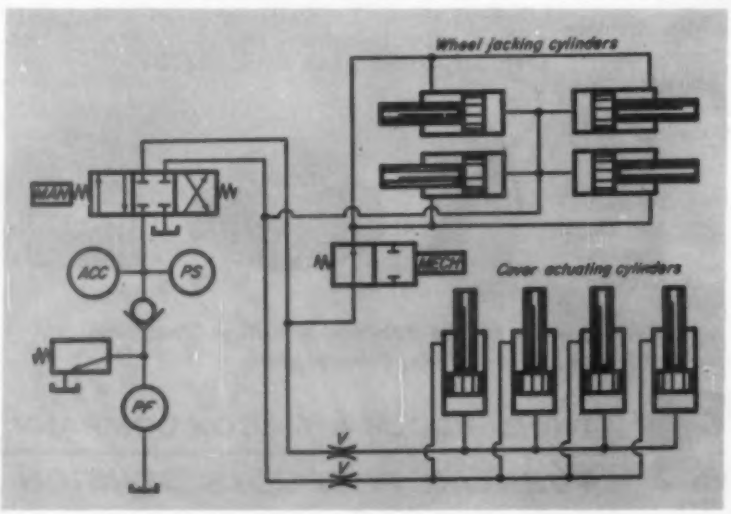


This circuit actuates two sets of cylinders in order without a sequence valve. It's done by sizing the cylinders properly.

Self-sequencing circuit lifts hatch





● By **WALTER HAMILTON,**
Lewis Welding & Engineering Co. Bedford, Ohio, formerly with Cleveland Pneumatic Industries

THE hatch covers are made in eight sections, four sections open forward and four aft. The sections are hinged together. When the cover opens, the sections lift and fold back against each other like an accordian. The center and end hinges ride on wheels to support the 12-ton cover assemblies.

To protect the hatch cover gaskets, small jacking wheels extend and break the cover and gasket

4-BAR LINKAGE actuates the hinges connecting the sections. As the cylinder extends, it rotates the cover sections around the hinge pin, and opens the hatch. The sections rotate a full 180 degrees from closed to open.

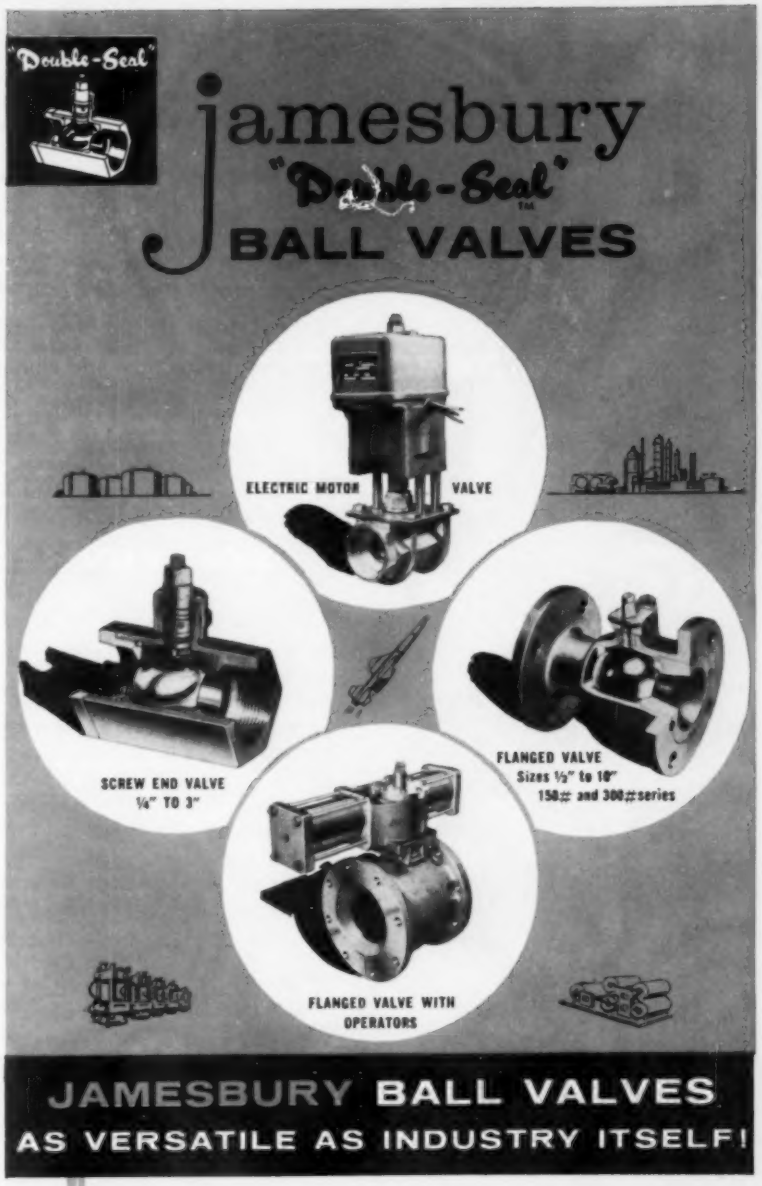
WHEEL JACKING CYLINDERS operate first because they require less pressure than the cover actuating cylinders. The shut-off valve traps oil in the wheel jacking cylinders while the cover is moving. A pressure switch starts the pump motor when the accumulator unloads, and stops it when the system reaches maximum pressure.

covers

loose from its seat before the cover lifts. At first a sequence valve was used to actuate the wheel cylinders before the cover started opening. The circuit was later simplified by sizing the jacking cylinders so that they lowered the wheels at a lower pressure than that required to extend the cover actuating cylinders. This eliminated the sequence valves.

• **Accumulator holds pressure**—A 1500 psi fixed-displacement pump powers the circuit. A pressure switch stops the pump motor at maximum system pressure. An accumulator stores oil under pressure to close the covers if electrical power fails. The pressure switch re-starts the motor if the pressure drops.

When the 4-way valve shifts to open the cover, the 3-inch wheel jacking cylinders retract at 300 psi, and lower the wheels. The 5-inch cover actuating cylinders extend at 1000 psi. As the cover sections start to fold, they close a shutoff valve which traps oil in the wheel cylinders. This prevents the wheels from retracting until the covers are fully closed. ▼▼▼



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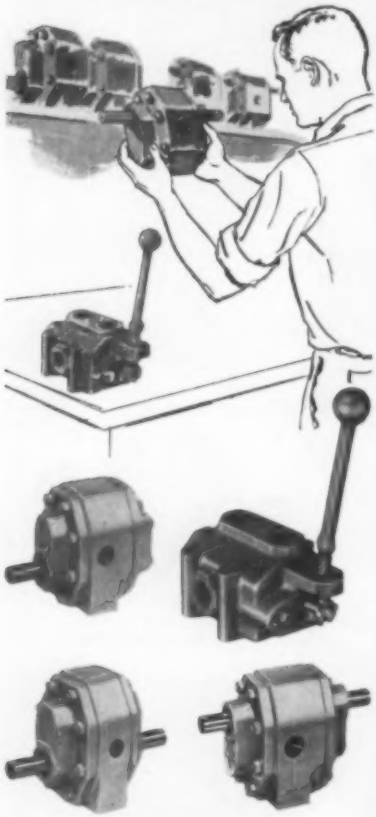

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Baffled reservoir reduces aeration

• By **RICHARD F. BRACKIN**, *Assistant Director of Engineering, Yale & Towne Mfg. Co., Philadelphia, Pa.*

Large, intermittent surge flows can cause aeration in the system. Here is how reservoir design can smooth the flow and eliminate air bubbles.

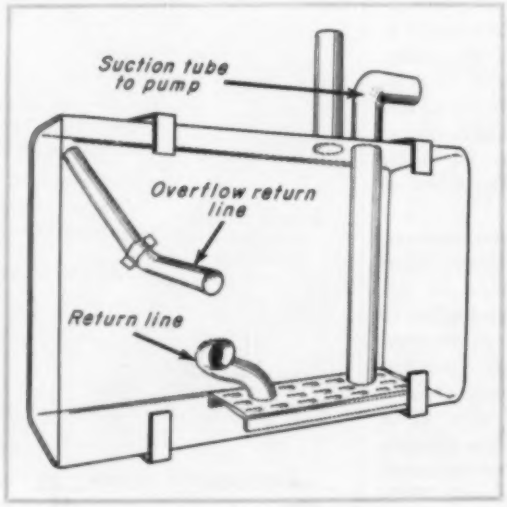
AIR in a lift truck hydraulic system lowers hoist speeds, causes spongy action, and pump cavitation. Surge flows during peak duty operations causes air bubbles in the tank.

The first approach to the surge problem was to place a perforated baffle in the reservoir so that it separated the return oil from the suction line. The idea was to confine turbulence to the return side of the tank, while fluid on the pump side would flow smoothly and without air bubbles. This method was only partially successful at higher speeds because bleeding through baffle holes was too slow, resulting in different oil levels on opposite sides of the plate.

Next we tried removing the plate and placing the return line at a lower level in the tank. This was an improvement, but the return oil in high speed truck systems set up a swirl effect which caused some bubbling and aeration.

The final solution was to use this swirling oil energy by directing it through a connection between return and suction lines to the inlet side of the pump. Now, with the hoist system operating at top speed, there is not a ripple in the oil remaining in the reservoir.

• **Tank has slotted channel**—A pipe conveys the oil into the tank at its midpoint, on the inboard side. The pipe leads into one end of a channel welded to the bottom of the tank. The suction line is at the other end of this channel. Slots in the side of the channel bleed off the excess volume during oil return and baffle oil to the pump on the suction side. The slotted channel also serves to mix cool and warm oil when the unit is idling. ▼▼▼



BAFFLED RESERVOIR design prevents system aeration by restricting return oil surge into the tank. Surge velocity energy is consumed by supercharging flow to the pump.

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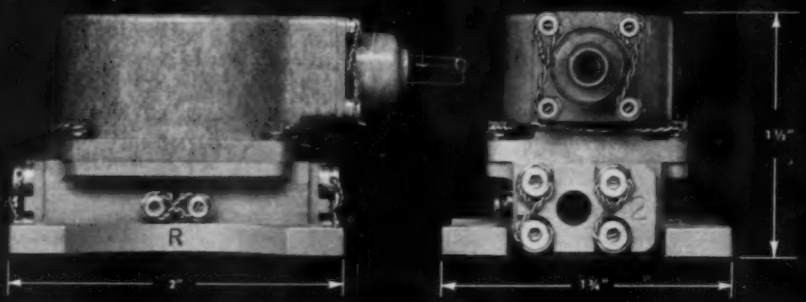

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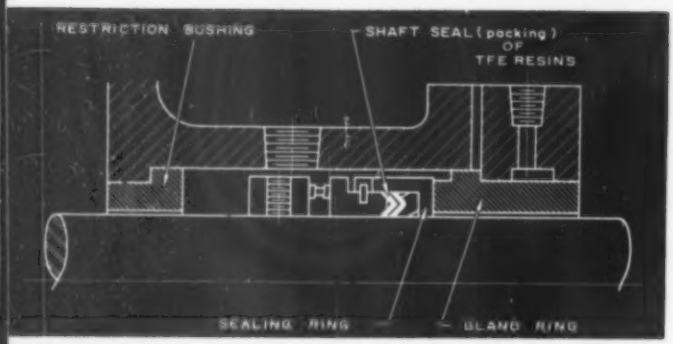

FIG. 1. SHAFT SEAL with V packing.

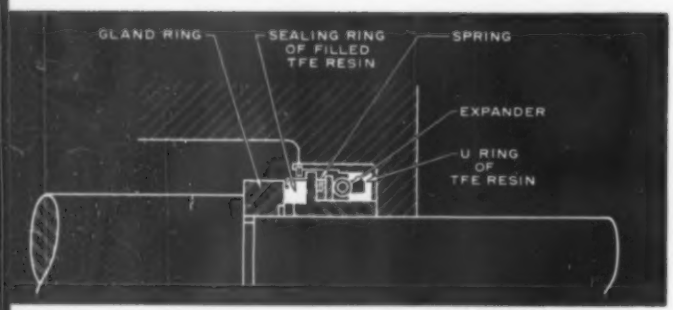

FIG. 2. GLAND RING with U packing.

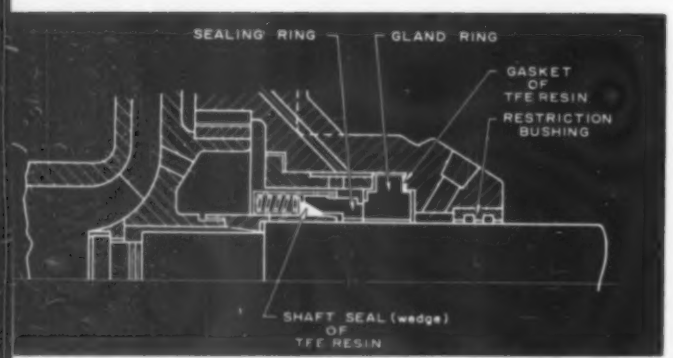

FIG. 3. WEDGE TYPE gland ring packing.

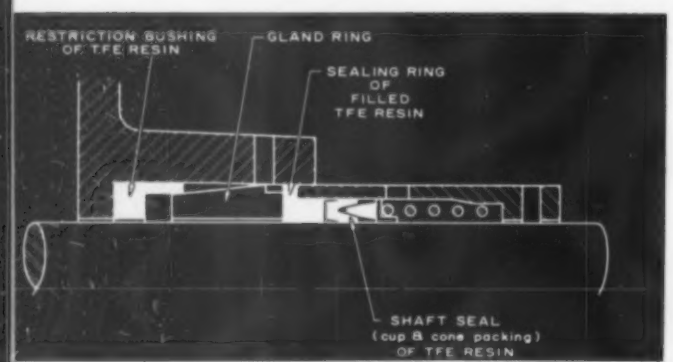

FIG. 4. CUP & CONE type shaft seal.

Mechanical seals . . . design, materials,

• By **L. H. GILLESPIE**, *Polychemicals Department, E. I. duPont*

DESIGN of mechanical seals differ, but their method of sealing is similar. Two highly finished flat surfaces in intimate contact with each other separate stuffing box pressure from outside or atmospheric pressure. One surface is sealed at the shaft and rotates with it. The other is stationary and is sealed at the pump casing or stuffing box.

A seal is similar to a flat, highly polished thrust bearing. Ordinarily a small amount of leakage lubricates the seal; however, as in a bearing, the materials of the mating surfaces must not gaul or sieze.

The portion of the seal rotating with the shaft is called the seal ring. The *gland ring* attaches to the pump casing and usually mounts rigidly. The *seal ring* mounts flexibly so that it can move endwise under spring pressure. The spring maintains uniform contact pressure against the mating ring and takes up slight shaft misalignment or runout. In many seals, a bellows or diaphragm gives all or part of the spring force bearing on the seal ring.

Sealing the rotating seal ring to the shaft can be with a bellows or diaphragm, or with an O-ring, V-ring, or wedge type seal. The stationary ring is generally mounted in the outer end of the packing box and sealed with a flexible gasket.

• **Internal or external**—The internal seal has the movable seal ring and its mechanism all inside the pump stuffing box, and completely submerged in the liquid. An external seal has the movable seal ring and its mechanism outside the pump and not in contact with the liquid. It is easier to adjust, but limited to low pressures unless it is balanced, since fluid pressure tends to open the seal faces.

• **Unbalanced or balanced**—Pump pressure on the movable sealing ring of an internal mechanical seal forces the ring against the stationary seal ring. There is also an opposite pressure from fluid film between the mating surfaces, forcing these surfaces apart. This pressure is about one-half stuffing box pressure.

Net pressure on the sealing ring of an unbalanced seal is the difference between internal pressure tending to hold the two rings together, and film pressure tending to separate them. Net force holding the faces together is one-half the internal pressure times the seal

installation

de Nemours & Co., Wilmington, Delaware

Teflon* in Mechanical Seals

DESIGN	REMARKS
Shaft Seals	Chemical inertness and heat resistance are advantages.
Sealing Ring	Usually made of graphite. Hard surface metals, ceramics, and Teflon are also used. Teflon is flexible and easy to handle and install. Low friction and high temperature range are advantages. Not used much above 600 ft per min. A zirconium filled composition is being used at 4000 ft per min. Mating surface to ring of Teflon is usually Stellite or other hard surface metal.
Gland Ring	Material must be compatible with seal ring. Teflon can be used here if the seal ring is a hard surface material.
Stationary Ring Gasket	Teflon is excellent for sealing stationary ring. Interchangeability of Teflon allows minimum stocking requirements.
Restriction Bushing	Teflon and other TFE resins are good because of their low friction. They also prevent shaft scoring in the event of shaft runout.

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face area, plus spring force. At low pressures this force does not cause high friction.

Balanced seals are used for higher pressures. By step-cutting the movable sealing ring on the pressure side of the seal, the area subjected to unbalanced forces is reduced. By proper design a net force which will balance the seal can be obtained. Spring pressure holds the surfaces together when the pump is not operating.

• **Stationary or rotating**—In all mechanical seals, one ring rotates with the shaft while the other is stationary. When the seal ring is spring-loaded, the seal is called a rotating type. When the gland ring is spring-loaded the seal is called a stationary type. In this type, the fixed seal ring rotates with the shaft.

Continued on page 92

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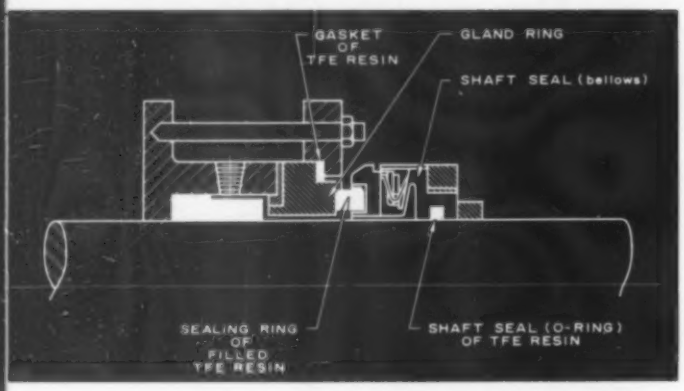

FIG. 5. GLAND RING, shaft seal, and seal face of Teflon.

● **Installation**—A seal's performance depends largely on installation accuracy, especially for designs having sliding shaft seals. In general, the maximum face runout should not exceed .001 in. At speeds below 600 ft/min such accuracy is not needed to maintain the face seal contact, but to prevent excessive sliding of the shaft sleeve at each revolution. This sliding deteriorates the shaft surface under the shaft seal and is one of the main causes of seal leaks. Various theories ranging from fretting corrosion to cell concentration have explained shaft surface deterioration. However, where face runout and seal sliding motion are small, shaft surface deterioration is also small. Excentric runout, which does not cause sliding motion, is less important but should be kept within .003 in. ▼▼▼

MECHANICAL SEAL GLOSSARY

SEAL RING Rotating seal face

GLAND RING Stationary seal face

STATIONARY RING GASKET Seals the gland ring to the pump casing

RESTRICTION BUSHING Reduces the clearance along the shaft where it passes through the casing of a seal that is being flushed with liquid.

INTERNAL SEAL Complete seal is inside pump casing

EXTERNAL SEAL Complete seal is outside pump casing

UNBALANCED SEAL Fluid pressure on seal ring greater than pressure tending to force the sealing surfaces apart.

BALANCED SEAL Seal ring pressure equal to pressure tending to force the sealing surfaces apart.

STATIONARY SEAL Gland ring is spring loaded.

ROTATING SEAL Seal ring is spring loaded.

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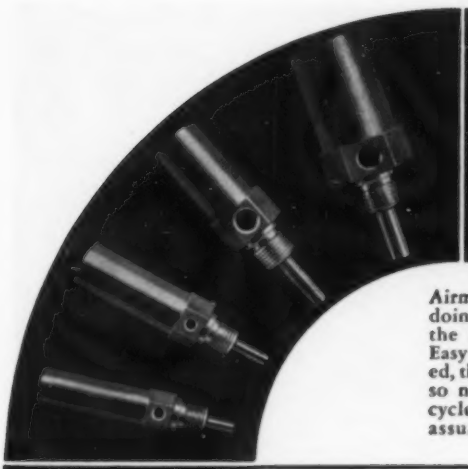

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3-Way Direct Solenoid ⅛" - 1"

3-Way Sequence Time-Delay ¼" - ¾"

3-Way Solenoid Pilot ¼" - 1"

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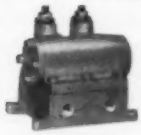

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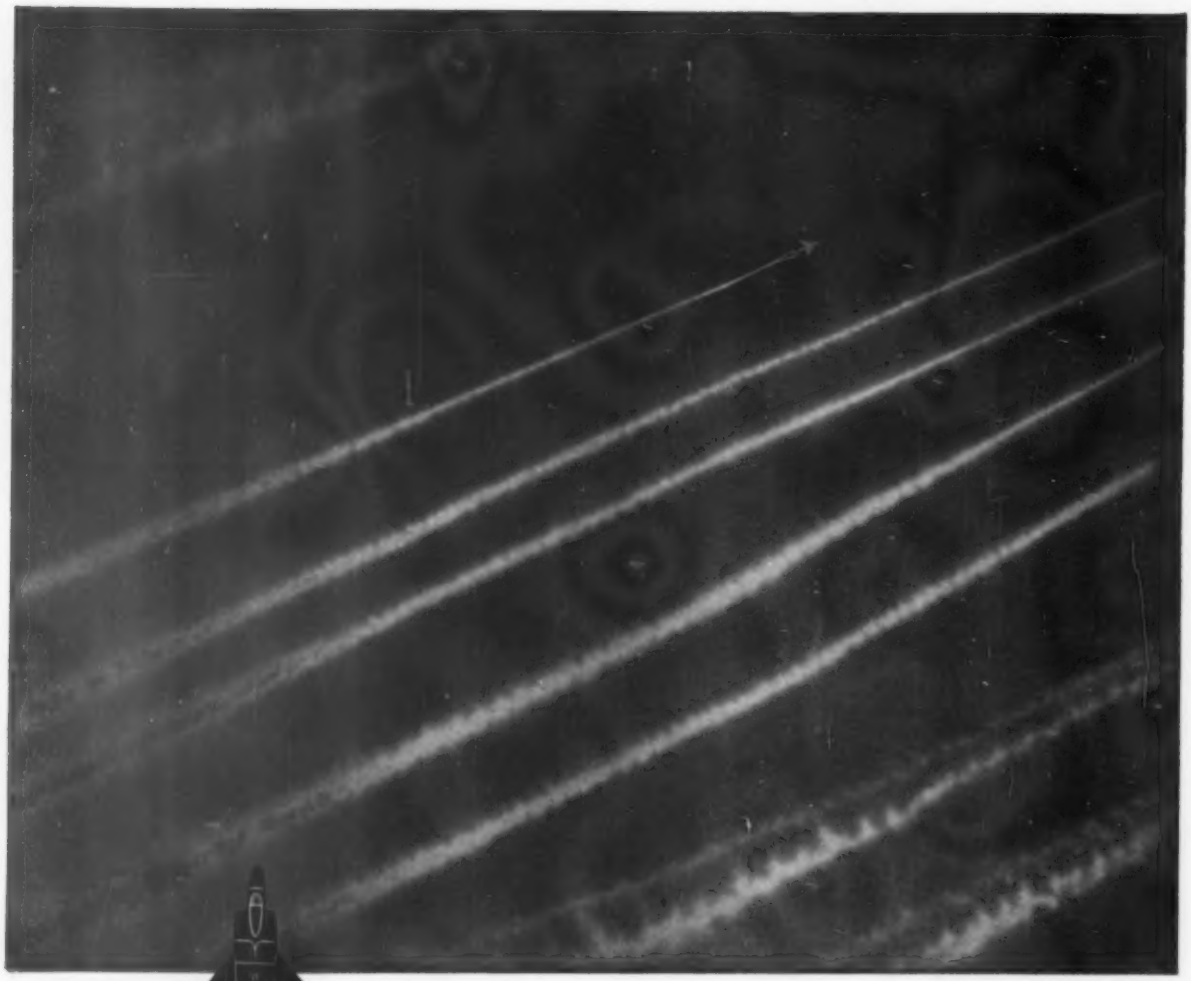

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AIRCRAFT SECTION

MISSILES • SPACE VEHICLES • GROUND SUPPORT

SERVO-CONTROLLED ROCKING TABLE CHECKS GYRO STABILITY 96

By Angus Eggleston

A 2-axis rocking table is actuated by electrohydraulic servomechanisms controlling paired cylinders. With cockpit mock-up for manual operation, the table can be "flown" in the laboratory.

AVIATION NEWS FROM THE FLUID POWER FIELD 100

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New design approach to hot fluid test equipment demonstrates some hydraulic and pneumatic systems for aircraft and missiles. For more information fill in and mail post card bound in this issue.

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Servo-controlled rocking table checks gyro stability

• By **ANGUS EGGLESTON**, *Project Engineer, Short Brothers & Harland Limited, Belfast, Northern Ireland.*

MOBILE CHASSIS containing electro-hydraulic components. The arm extending over the table is wired to the sockets at the side for monitoring and supplying the test specimen. Grilles circulate air in test area.

Gyro stability can be studied in the laboratory with the same accuracy as in actual flight. Electrohydraulic servomechanisms control paired cylinders to actuate a 2-axis rocking table.

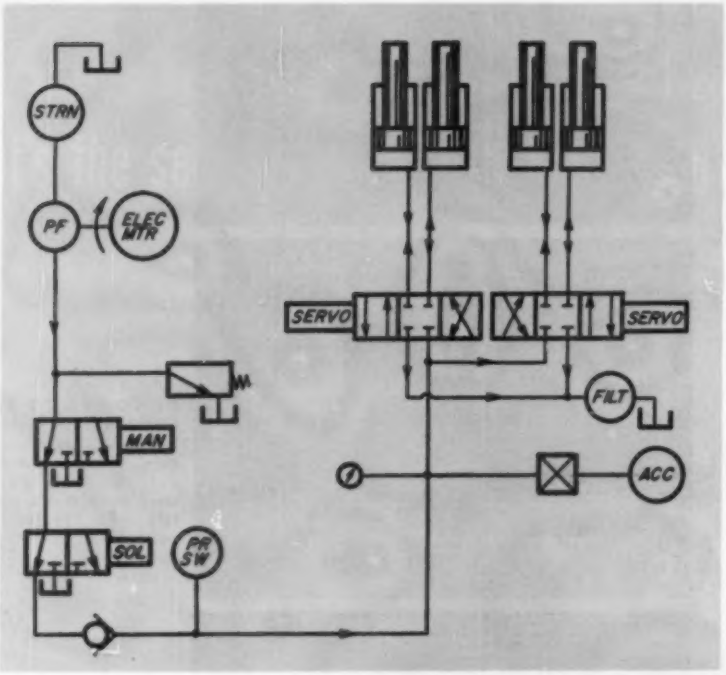
ROTATION of ±15° about each axis is controlled by a pair of single-acting cylinders through ball-ended connecting rods. Each pair of cylinders determines the axis inclination about which the other pair can cause rotation. Single-acting cylinders are used to avoid backlash in the drive. Since each piston exerts positive pressure, the forces on the table and its bearing are unidirectional. Rigidity of the loaded system is insured by mounting the trunion bearing directly on a single block containing the four cylinders.

• **Hydraulics**—The hydraulic system is pressure-controlled to operate at a nominal 1,000 psi. (Fig. 1) Fluid from the tank is passed by a constant delivery gear pump to a manually-controlled bypass valve on the control panel. A relief valve tapped into this line vents back to the tank in case of trouble in the normal pressure control system. From the bypass valve, fluid is channeled through a solenoid-operated vent valve to an accumulator and to the two servo valves, which meter supply to the cylinders.

Servo valves (pressure-balanced spool type) are modified to a zero overlap on all lands to obtain sensitivity. The increased leakage was tolerable for this project. Flexible hose lines are avoided because their pulsations might introduce phase lags, and cause system instability. Oil returning from servo valves to tank passes through a micronic filter, eliminating the need for a tank capable of withstanding system pressures.

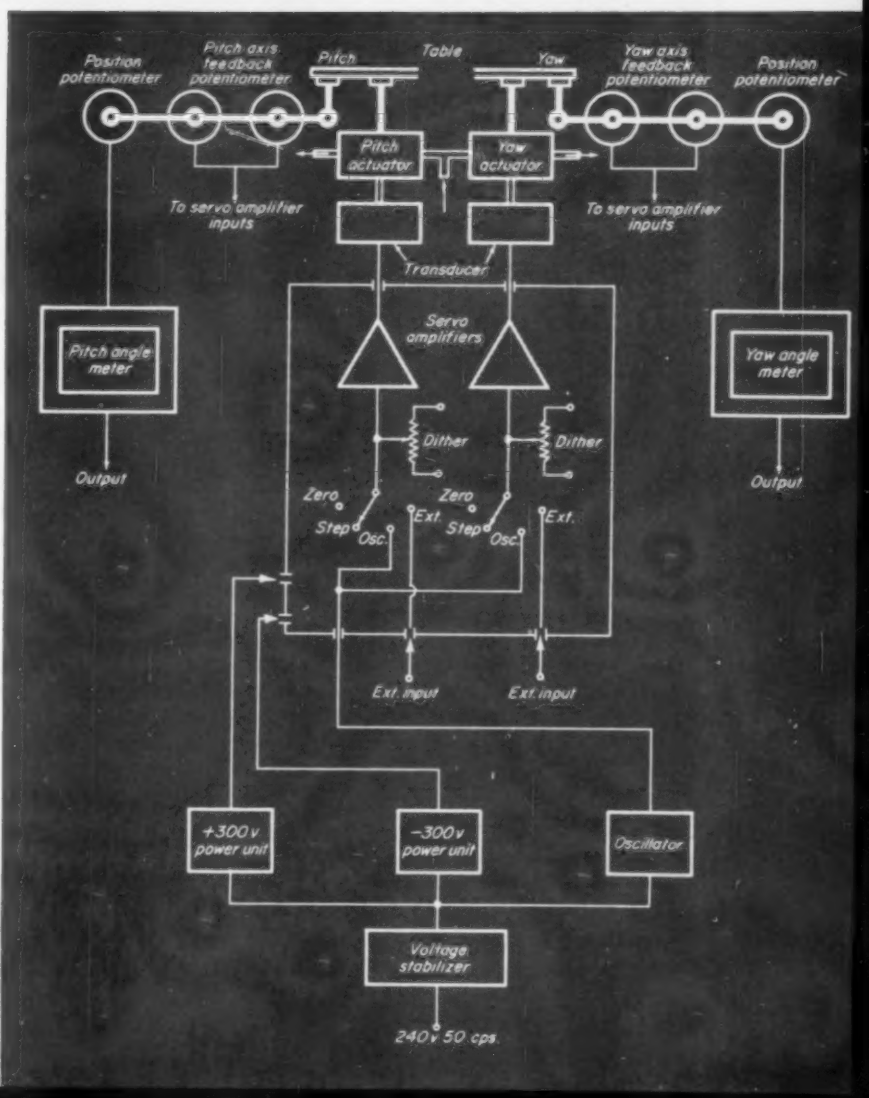
Valve buzz was encountered when the system was first tested, even with the servo-amplifiers switched off. The cause was acoustic resonance of the fluid column between the control valves and the accumulator. The noise was eliminated by making an abrupt change of cross section of the supply lines at the inlets to the servo valve blocks. This took the form of drilled diaphragms which damped out the resonating pressure waves in the fluid.

Electric power sources consist of two units, one positive, one negative, of 300 volt output ±0.15% for loads to 200 milliamps. The two packs are interchangeable, their polarity determined by the plug connections.



ROCKING TABLE HYDRAULIC CIRCUITS showing servo valves operating the single-acting cylinders in pairs. Servo valves are fed from an accumulator.

TWO CLOSED LOOP servomechanisms independently control table movement. External input can be connected to cockpit mock-up for manual pilot operation.



• **Electrical control**—Two, independent, closed loop servomechanisms control the table. In each circuit, an amplifier passes signals controlled by input voltage to an electromagnetic torque motor whose armature drives a hydraulic control valve. This valve meters oil to and from the cylinder pairs, producing table motion. Mechanical linkage transmits the motion to potentiometers, which are connected in parallel to produce a smooth feedback signal. Voltage of the signal is in counter-phase to the input voltage, the amplifier output ceases, the table come to rest, and the control valve returns to its central position.

One of the potentiometers provides a monitoring signal proportional to table displacement. Signals can either be displayed on the built-in meter on the control panel or fed out to an external measuring device such as a pen recorder.

Panel-mounted table controls consist of one for monitoring the servo-amplifiers, and one group for each axis of rotation. Each axis control has an input selector

Concluded on next page

SEALOL SWIVELS

Save Space
Cut Power Loss

for example...

6 G.P.M. at 3,000 P.S.I. aircraft-type swivel illustrated in ½" O.D. tube size. Extremely low swiveling torque (10 inch-pounds at 3,000 P.S.I.) means minimum power loss. Meets or exceeds MIL J-5513A.

and then...

600 G.P.M. special, multi-passage fuel transfer swivel shown for use with JP-4 and similar fuels. Flow rate 600 G.P.M. at 50 P.S.I.G., pressure drop less than 3.2 P.S.I., 18¼" C. to C. of end passages.

Write or phone S. Biello for further details — **STuart 1-4700**
(for direct distance dialing, area code is 401)

SEALOL CORP.

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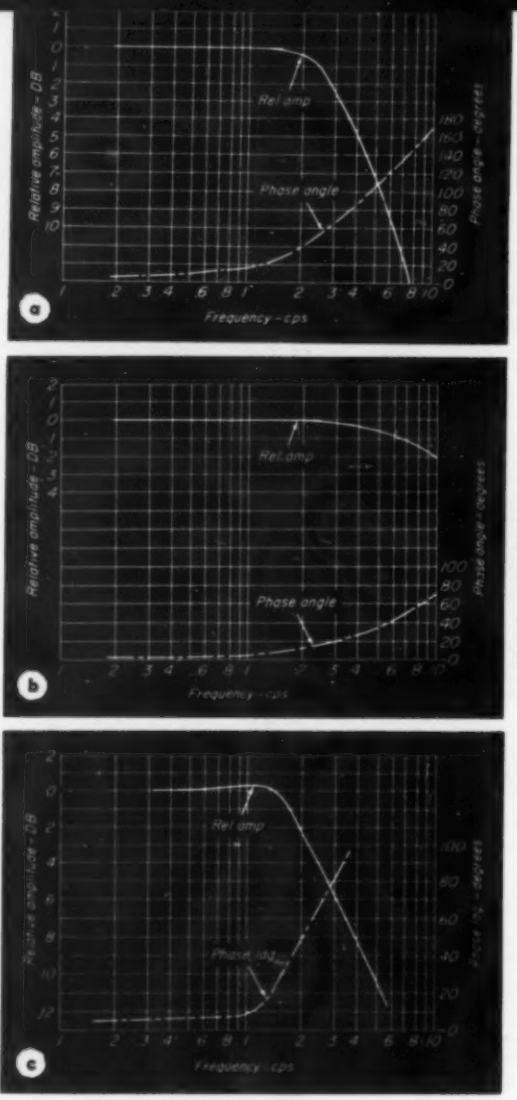
Circle **106** on Time-Saver Card

ROCKING TABLE



FREQUENCY RESPONSE of rocking table: (a) minimum gain, large amplitude, (b) maximum gain, small amplitude, (c) rate limit, 1½ radians per second.

switch permitting control from either a built-in potentiometer, the variable frequency oscillator, or an outside source. A reversing switch at the potentiometer provides step-function signals of pre-set amplitude for rotating the table at maximum rate. Response may be adjusted to suit inertia loading by means of amplifier gain controls.

Input power level to the servo valves was so low that static friction affected them enough to distort the response of the table to small sinusoidal input signals. In effect, there was a dead zone about the mid-position of the valves which caused flattening of sine wave peaks. When a 50-cps, a-c signal was superimposed on the input to the amplifier, the resulting valve dither eliminated the stiction, and good sensitivity was achieved. The strength of the a-c signal was made adjustable, between 0 and 0.5 volts at the control panel, so that the valves could be kept operable at all times without transmitting unwanted vibrations to the table.

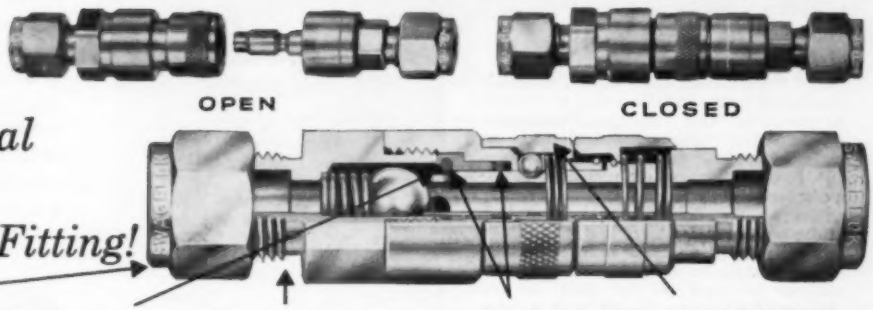
• **Performance**—With the center of rotation 1.5 inches below the working surface, inertia loads up to 11.5 lb. ft.^{2} can be accommodated on the table. This is sufficient to include most autopilot types, and trends are toward smaller designs.

Maximum angular velocity limit is 2 radians per second about each axis. If higher intertia loads are required, correspondingly lower output rates are used. This imposes a limit to the frequency response of the table, but it is adequate to meet all needs in simulating the responses of present aircraft and most missiles. ▼▼▼

Circle 36 →

Swagelok Quick-Connect Fitting Installation in Boeing Airplane Company, Seattle, Wash., Test Facilities for Boeing 707 Jet Stratoliner.

Here's the secret of this fast, positive-seal Swagelok Quick-Connect Fitting!



1. Swagelok Quick-Connects with single end or double end shut off for tube to pipe, tube to tube, bulkhead tube to tube applications are available in brass and stainless steel in sizes for ¼" and ⅜" O. D. tubing.

2. Flow resumed instantly and vacuum tight seal assured when connection is made.

3. Light, compact, streamlined design. Occupies little space. For use with portable equipment, and bulkhead or panel applications.

4. Instant-acting seals completely prevent loss of pressure when fitting is disconnected.

5. No twisting, turning or wrench action necessary. Easy straight-line finger tip pull or push action for instant connecting or disconnecting.

In the Boeing Airplane Company photo shown above, the tubes are instrumentation pressure lines running from the large jet engines on test stands to the patch board, where the lines are coupled into measuring devices.

The Boeing Airplane Company adopted this positive Swagelok Quick-Connect Fitting to simplify test installations, and substantially cut down test set-up time. Both ends of the many pressure lines are Swagelok-equipped. Previously, engineers used a screw-type fitting which required a wrench and valuable time-consuming operations to tighten and remove.

Swagelok engineers are equipped with experience, ability, and a wide range of tube fittings designed to meet your individual problems. Quick delivery of Swagelok tube fittings from local distributor stocks.

Swagelok® TUBE FITTINGS

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884 East 140th Street • Cleveland 10, Ohio
Crawford Fittings (Canada) Ltd., Niagara Falls, Ontario, Canada

ADAMS FACT FILE #2

PLANT AIR

Moisture Chief Cause of Trouble . . .

Every company today is looking for ways to offset the increased costs of labor, material, equipment and services. At a gasoline station you expect "Free Air", but in industry it is a major expense. Perhaps in your own plant, for an investment in a few minor compressed air system alterations, significant savings are possible.

Water, sludge, rust, oil and dirt in compressed air systems are prime causes of maintenance and production down-time. Water vapor condensing in air lines tends to corrode the piping. Also, water present in the piping may freeze during winter, causing serious reduction of compressed air supply. Such restrictions are often difficult to locate and thaw. This same line moisture may emulsify lube oil destroying its lubricating value and the resultant mixture has high fouling characteristics. Frequently, ice will form within the tool itself since expanding air cools the moisture . . . tool efficiency will be seriously affected.

Some of the Other Problems Created By Wet Compressed Air . . .

Wet compressed air is not only a construction and production tool problem. Faulty paint jobs, contaminated chemical and food products can often be traced to moisture laden compressed air. Waterhammer, unequal pipeline thermal expansion and line leaks also result from collected moisture. In addition, air lost through traps, and in blow-down of compressed air lines provide no useful work . . . represent a sizeable power loss.

You Can Lick Compressed Air Moisture Problem . . .

All of these hidden costs can be virtually eliminated by the installation of an Adams Aftercooler and Cyclone Separator between the compressor and receiver tank. By cooling discharge air to within 10° F. of cooling water temperature — guaranteed with Adams standard Aftercoolers — the moisture can be removed at the separator. Pressure loss is less than one-half pound on these units including the separator. In severe cases, moisture removal of over 90 per cent can be obtained by cooling the air with Adams 2° Aftercooler to within 2° F. of water temperature.

Air Filter for Final Protection at Point of Use . . .

As an added safeguard for expensive tools and equipment, an Adams Poro-Stone Air Filter should be installed just before the air is used. These filters remove all solid material picked up by the air stream. With an Adams Aftercooler, Cyclone Separator and Air Filters clean, dry, trouble-free air is supplied to your production tools. You get continuous service with minimum maintenance.

For further information on how the complete line of Adams air equipment can solve your compressed air problems, write today for your free copy of Bulletin No. 712 on Aftercoolers and Bulletin No. 117 on Poro-Stone Air Filters from the R. P. Adams Company, Inc., 249 East Park Drive, Buffalo 17, New York.

Circle **2** on Timer-Saver Card

AVIATION NEWS

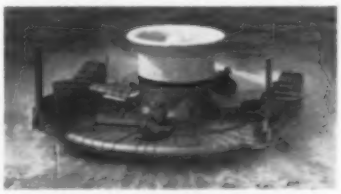
from the fluid power field

ATLAS LAUNCHING SYSTEMS

Twelve additional hydraulic power systems for the Atlas ICBM launching sites will be built by the **Rucker Co.** of Oakland, California. These systems include hydraulic locking and lifting equipment for the 800,000-lb., underground silo doors. Also included are high pressure pumping units, accumulator equipment, and control valves and actuators to operate the 60-ton, blast flame tunnel doors and vent systems.

BRITISH SKIMMER

This unusual craft is a new pneumatic vehicle that rests on an 18 inch column of air, exerting a pressure of 10 pounds per square foot. To generate this cusion, a 450 hp radial engine drives a



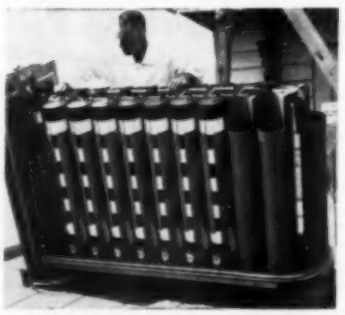
blower to the flow of 4600 cubic feet per second with a velocity of 150 feet per second. About 100 hp provides the air stream to propell this Saunders-Roe machine. Side ducts provide propulsion and directional control. Called the Hovercraft, the low-altitude aircraft went from the drawing board to its first hover in eight months.

James G. Weldon has been appointed hydraulic department manager at **Bendix-Pacific** Division of Bendix Aviation Corp. Formerly hydraulic sales manager, he will head all engineering, manufacturing, and sales operations for the firm's hydraulic products. Other hydraulic department appointments include Paul B. Heineck, manager of application engineering (sales); Carroll Mills, manager of contract administration; and Robert M. Stryker, factory manager.

Cale H. Merrill has been appointed as supervisor of commercial sales and service in the **Aero Hydraulics Division** of **Vickers, Inc.** His new assignment was created to provide improved service to airlines. He will supervise field service, product improvement, spare parts and service training programs for airline personnel.

PNEUMATIC EJECTOR FOR WEATHER DATA

An airborne ejection device has been developed by **Stratos Western Branch** as a part of a launching system for collecting weather data in the Air Force's proposed global air weather reconnaissance system. The free piston pneumatic device, shown at the



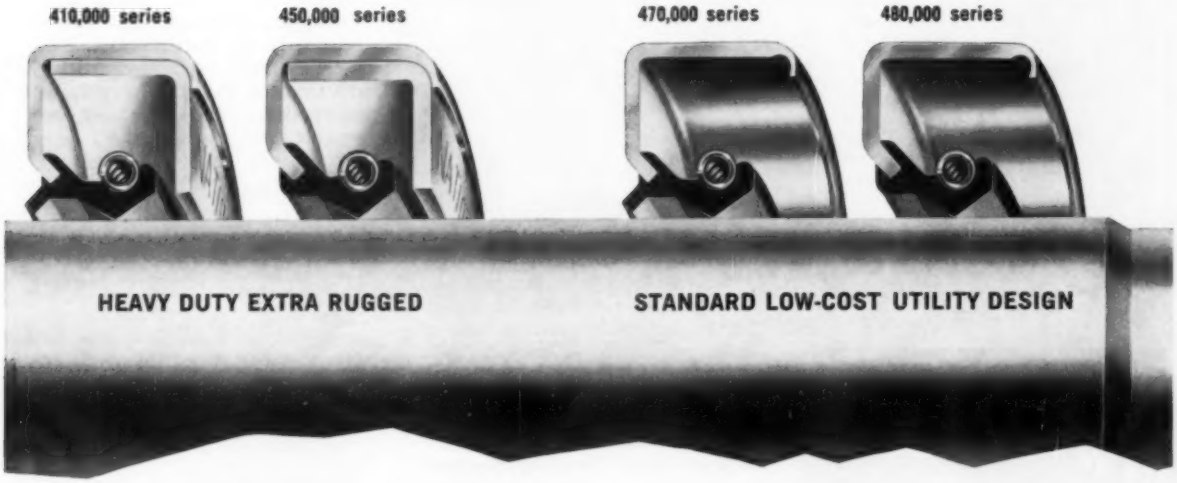
far left, ejects a 20-pound 'dropsonde' instrument at 35 feet per second. This design offers maximum stroke for its length by eliminating a piston rod. The entire launching system is being developed by the Boeing Airplane Company.

NATIONAL® OIL SEAL LOGBOOK

Presenting...

A rugged, dependable new shaft seal for a broad variety of applications

NATIONAL BUD* SEALS



New designs proven in 4 years of field application

Permanent bonded sealing lip, longer life, leakproof sealing

Rugged case won't distort under severe press fit

Phosphate coating avoids rust

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Sealing materials for temperatures —65° F to 400° F

Operates in most oils or industrial fluids

National Seal engineers — who brought you Syntech® and Micro-Torc® —now offer a ruggedly simple new advance in precision shaft sealing —National BUD (Bonded Universal Design) Oil Seals.

BUD seals are designed for a broad variety of applications, including many where more complex single-lip and double-lip designs were previously specified.

Full details and application engineering help on National BUD or other oil seals are available from your National Seal Division, Field Engineers. See the Yellow Pages under "Oil Seals" or write direct to Redwood City, Calif., home offices.

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Circle 1 on Timer-Saver Card

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SPRING-LOADED

Wiper **Ring**

This patented closed joint ring provides squeeze - grip action, assuring complete contact on the rod at all times. Maintains uniform, continuous pressure on wiper edge. Rods are always clean in any temperatures.

Fall "CJ" Wiper Rings operate most effectively under extreme conditions of dust, glaze, oil, grit, powder, gases, sand, ice, etc. Available in diameters ½" through 13". For any commercial use. Used by military and aviation industry since 1944.

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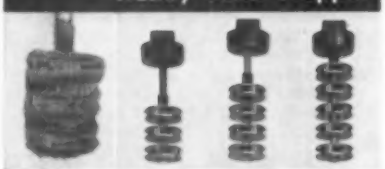
1820 N. 12th St. Toledo 1, Ohio
Est. 1935

NEW MAGNETIC CLEANER for HYDRAULIC POWER UNITS the Kebby Tank-Trapper



★ Powerful Alnico V Magnets
★ Highest Active Area
★ Engineered for Power Concentration
★ Easy to Apply
★ Low Priced . . . Quick Delivery
★ No Moving Parts . . . No Maintenance

MEETS NEW J.I.C. HYDRAULIC STANDARDS

The Kebby Tank-Trapper is specifically designed to complete the protection of hydraulic systems against damage by iron particles worn off moving parts of various components. It picks up material missed by the filter and prevents premature filter loading. Expensive shut downs and service calls are drastically reduced. Write for Bulletin 1-500-59.

THE KEBBY COMPANY
2320 Custer Avenue Rockford, Illinois
Designers and Manufacturers of Magnetic Devices, Kebby Mite and Filtray Coolant Cleaners

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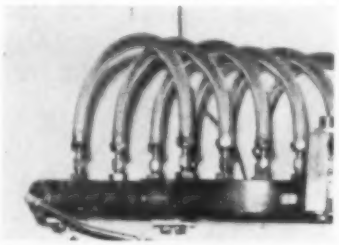
AIRCRAFT COMPONENT DATA

Corrugated Metal Hose . . . is multiple ply

For temperatures of —450 to +1200 F. Withstands cyclic hydraulic shock loading (from pump



pulsations, rapid valve opening, and sudden stops of hydraulic equipment) at peak impulse pressure of 4500 psi. RF-69.—*Flexonics Corp., Maywood, Ill.*

Circle **500** on Time-Saver Card

Proportional Braking System . . . for jet liners

Anti-skid braking system automatically brakes in proportion to wheel slip. It senses a drop in wheel speed and controls the ratio of brake pressure to pilot's brake pedal force. This controls wheel slip and gives maximum

wheel-to-ground torque. An analog computer meters pressure to the brakes. All components of the Hytrol Mark II can be added to conventional aircraft braking systems. System will be used in the Convair 600 jet liner.—*Hydro-Aire Co., Burbank, Calif.*

Circle **501** on Time-Saver Card

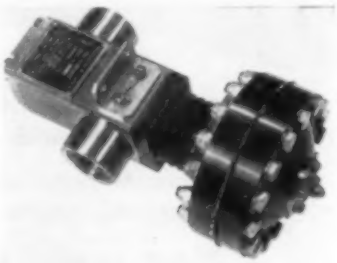
Axial Piston Pump . . . for 5000-psi

Bulletin A-5232-A describes Model A-12900 series pump for hydraulic test stands, missile launchers, jet engine starting systems, and similar applications where long life, high pressures, and high flows are required. Bulletin contains capacity data, sizing information, weights, horsepowers.—*Vickers Inc., Detroit, Mich.*

Circle **502** on Time-Saver Card

Gas Regulator . . . is dome-loaded

Made of corrosion-resistant materials. Handles gas inlet temperatures to 450 F. Adjustable from 200 to 2500 psig at 5% accuracy.



Dome-loaded design uses gas loading rather than a spring-loaded diaphragm. This gives lower spring rate and less pressure variation.—*Western Sky Industries, Hayward, Cal.*

Circle **503** on Time-Saver Card

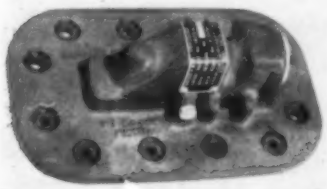
Manual Shutoff Valve . . . is lightweight

Weighs only 5 ounces, handles pressures to 10,000 psi. Made of 303 stainless steel. For test stands and similar equipment. Valve's control knob requires 5½ turns from full open to closed. Temperature range is —40 to 400 F. Model P6-406.—*James, Pond & Clark, Inc., Pasadena, Calif.*

Circle **504** on Time-Saver Card

Bleed Valve
. . . mounts outside missile

Valve meters constant, 50 cfm of 50-psi air to ICBM control system. Mounts outside missile. Only actuation lever is exposed. Valve

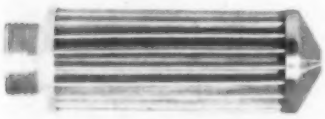


body and closure is HK31 Magnesium alloy, seal is silicone rubber.—*Koehler Aircraft Products, Dayton, Ohio.*

Circle **505** on Time-Saver Card

Filter Element
. . . is brazed

High temperature braze is acid-resistant. Maximum operating temperature is 1700 F. Elimination of

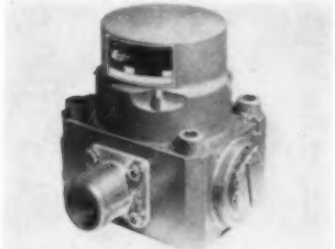


silver brazing reduces the envelope size.—*Skinner Filter Div., Hydrodyne Corp., North Hollywood, Calif.*

Circle **506** on Time-Saver Card

Servo Valve
. . . for 18 gpm

Electrohydraulic servovalve has hydromechanical feedback to reduce flow force reactions. It also hydraulically centers the pilot position without spring hysteresis and



null shift. It is a 2-stage, 4-way control valve. Operates to 18 gpm at 3000 psi and at temperatures from —65 to 275 F. Model 6104. —*Kearfott Co., Little Falls, N. J.*

Circle **507** on Time-Saver Card

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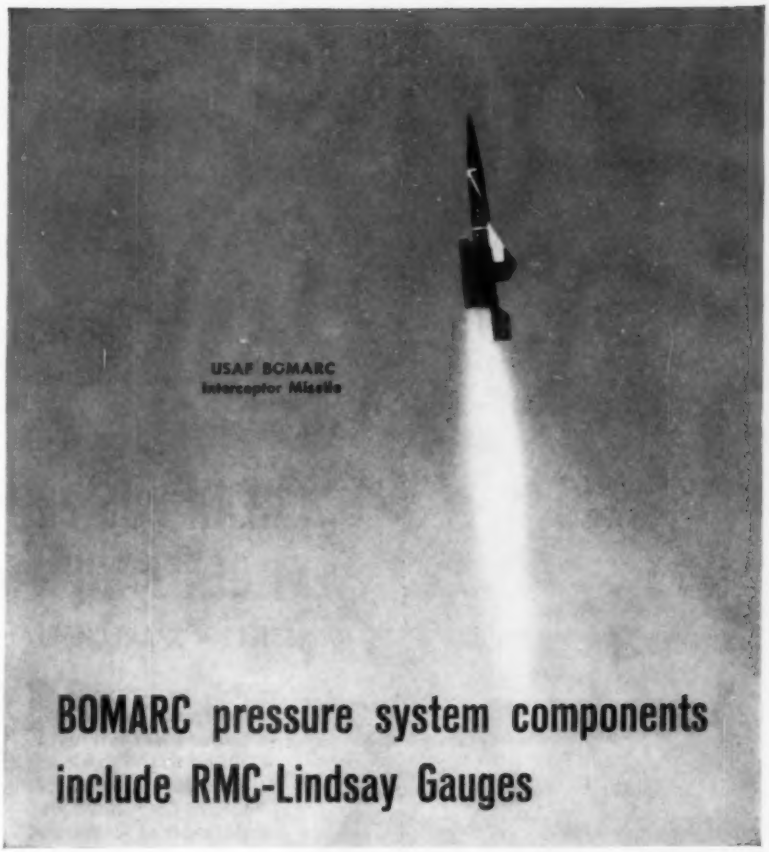

BOMARC pressure system components include RMC-Lindsay Gauges

The Boeing Bomarc, a true "push-button weapon," automatically seeks out and destroys its target. In such a weapon there can be no compromise in the performance requirements for its mechanical and electronic components.

Among these components, RMC-Lindsay "gearless" pressure gauges are employed on two Bomarc assemblies—the ram jet full pressure system and the nose air pressurization system.

RMC-Lindsay gauges withstand shock tests of 100 G's. They are checked for accuracy in vibration tests ranging from 10 to 2,000 cps at 35 G's and at ambient temperatures from −65° F. to +430° F. There is no linkage, no gear train—the indicating pointer is attached directly to the end of the helical bourdon coil. Qualified under MIL-E-5272.

Model #6906
(Half Size)

All RMC-Lindsay gauges are built to the most exacting standards for accurate performance under the most rigorous conditions encountered in modern industry, in jet aviation, in astronautics.

Complete engineering and production facilities are available at RMC for subcontract work in pressure system components—gauges, valves, switches, etc. Write, wire or phone:

ROCHESTER MFG. CO. OF CALIFORNIA
1401-C So. Shamrock Ave., Monrovia, Cal.

ROCHESTER MANUFACTURING CO., INC.
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RMC
LINDSAY PRESSURE GAUGES

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HIGH SPEED GEAR PUMPS FOR THE NEXT GENERATION

OF AIRCRAFT • MISSILES • SPACECRAFT

High performance hydraulic pumps by Eastern are uniquely suited to the exacting operating requirements demanded in the craft of tomorrow.

Check these Eastern gear pump features — do they suggest a solution to your present design problem?

Small size: Eastern gear pumps are the smallest, lightest made. Airborne servo system pump shown delivers 1.5 gpm @ 1500 psig — measures only 1⅞" x 1⅞" x 2¾", weighs 9 oz.

Wide performance range: pumps available have theoretical displacement from .0016 to .0419 cu. in. per revolution — flow from .025 to 2.0 gpm, pressures from 0 to 2000 psig, at speeds to 24,000 rpm. Weights with motor range from 1.5 to 8.5 lbs.

Unaffected by extreme environments: rugged, reliable Eastern units take loads to 50g in stride — shrug off temperature differentials to meet MIL specs.

Flexibility, economy: mass-produced components can be teamed into the precise configuration you need. Creatively-engineered custom pumps also available.

Contact Eastern for creative contributions to help you solve your hydraulic pump or power problems. Write for Bulletin 360 — your complete new guide to Eastern aviation products.

Hydraulic power • electronic cooling • refrigeration-type cooling pressurization-dehydration • servo-valve hydraulic systems

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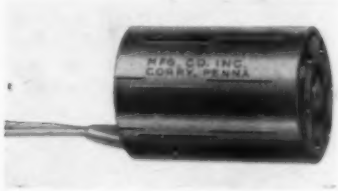
Circle **43** on Time-Saver Card

AIRCRAFT COMPONENT DATA

Solenoid Valve . . . is versatile

Capable of handling jobs of larger valves, this unit weighs only .21 pounds. The solenoid valve operates on 400 cycle, non-rectified



a-c current. It is adaptable to a wide variety of sizes and configurations.—*Aero Supply Mfg. Co., Inc., Corry, Pa.*

Circle **508** on Time-Saver Card

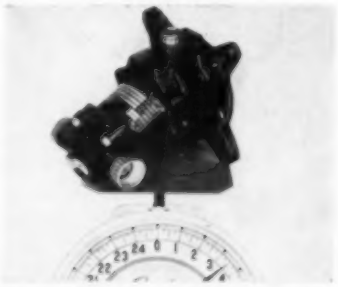
Control Valves . . . in new brochure

Photographs and descriptions of airborne hydraulic and pneumatic control devices. Products illustrated are: solenoid valves, directional control valves, check valves, pressure reducing valves, flight control, servo valves, and master brake cylinders.—*Hydra-Power Corp., New Rochelle, N. Y.*

Circle **509** on Time-Saver Card

Hydraulic Motors . . . high energy, low friction

Delivers more than 4.5 hp/lb 5300 rpm. Displaces .40 cu. in./rev. Maximum inlet pressure is 3000



psi. Volumetric efficiency is 96% to 98%. Overall efficiency is 92 to 93%. Temperature range, —65 to 275 F. 63000 Series.—*The Cornelius Co., Minneapolis, Minn.*

Circle **510** on Time-Saver Card

Circle **32** on Time-Saver Card

"Helping Hands" for Hundreds of Jobs!

Clippard *Minimatic* **miniature air devices**

Small but rugged ⅜" and 9/16" bore AIR CYLINDERS, 2, 3, and 4-way AIR VALVES, MINIATURE NEEDLE, CHECK and FLOW CONTROL VALVES, valve operating SOLENOIDS, FITTINGS and ACCESSORIES save space, weight and money for you. Ideal for jigs, tooling and automation.

Write, NOW for Bulletin 8-59

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Manufacturers of Miniature Pneumatic Devices, R.F. Coils, Electronic Equipment

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Accurate, Automatic temperature control

OF HYDRAULIC AND HEAT TRANSFER FLUIDS

Peak performance of hydraulic equipment is assured by the precise, dependable oil temperature control maintained by the Sterlco Temperature Control Valve, Series 150E. It's completely automatic, self-contained, compact and low cost . . . operates in any position. Write for details.

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Temperature Control Valve

Series 150E

Leaders in temperature controls since 1916

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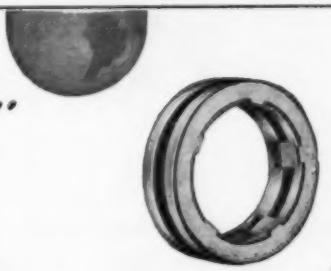
Industrial Control Division

"All the world's ***Our*** *stage"...*



Manufacturers all over the world have discovered the importance of fitting 'SUPERFECT' Oil Seals and Hydraulic Packings for perfect performance under the most exacting conditions.

There is a type of Seal to meet virtually every need. Our Research Department is available to help solve any sealing problems.

A brand new catalogue is in the course of preparation. May we reserve one for you?

SUPERFECT

SUPER OIL SEALS & GASKETS LTD. KINGS NORTON FACTORY CENTRE, BIRMINGHAM 30 • ENGLAND

Rx The RECOMMENDED PRESCRIPTION for CURING MOISTURE...DIRT and LUBRICATION PROBLEMS in COMPRESSED AIR LINES

Arrow

FILTERS

COMBINATION ASSEMBLIES

LUBRICATORS

TRIO CONTROLS

DRAIN TRAPS

AUTO-PNEUMATIC CONTROLS

OPTIONAL WITH THE NEW Arrow NON-SHATTER PLASTIC BOWLS

Pipe Line Sizes ¼"–⅜"–½"–¾" and 1"

Catalog #50 Sent on Request

REDUCE { REPAIR DOWN TIME MAINTENANCE } COSTS

Arrow TOOLS, INC.
1934 S. KOSTNER AVE. • CHICAGO 23, ILLINOIS

DEALERS IN ALL PRINCIPAL CITIES

CANADA— Higginson Equipment Sale, Ltd. Burlington, Ont.
EUROPE— Herion-Werke

Circle 13 on Time-Saver Card

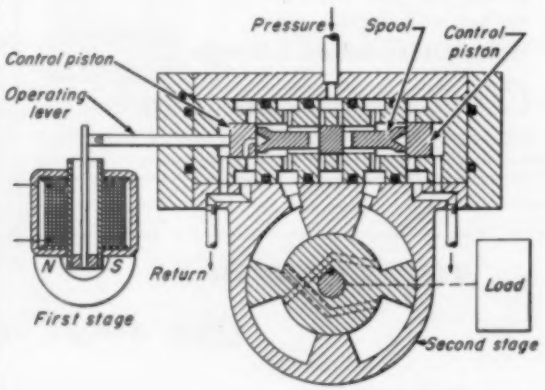
FLUID POWER PATENTS

PRESSURE FEEDBACK SERVO VALVE

Pressure feeds back from the actuator to the second stage spool and opposes spool movement. This pressure prevents oscillating and overcontrolling. The valve has a minimum internal leakage and is not affected by temperature changes.

The drawing shows an electromagnetic first stage input, however, the input may be a nozzle-flapper valve or a mechanical linkage.

When the operating lever moves the spool assembly right, the center land of the spool uncovers the pressure port, directing fluid to the left port of the actuator. The actuator rotates counter-clockwise. Initial



movement of the spool valve assembly to the right is proportional to the current supplied to the first stage windings. Fluid returns to the reservoir through the port on the right side of the actuator.

As the pressure rotating the actuator counterclockwise builds up, it moves the spool assembly left, because the land at each end of the spool has a greater area than the center land. Thus, the actuator approaches the desired velocity without overshoot.

U. S. Patent 2,889,815 *by Wayne B. Lloyd, assigned to Westinghouse Electric Corp., East Pittsburgh, Pa.*

SELF-CHARGING ACCUMULATOR

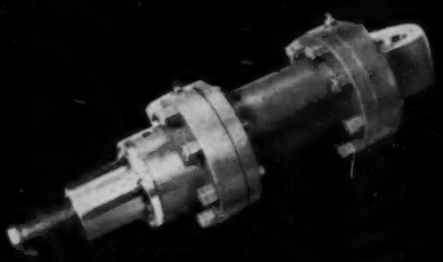
The unit consists of an accumulator where any leakage of precharge air is replaced during normal operation of the accumulator.

During periods of low demand, oil is forced into the accumulator from the hydraulic system, moving

Continued on page 110

Circle 12 →

Here is power cylinder engineering when you need it!



At Anker-Holth we are used to **hurry-up** calls.

We are used to tough problems in pneumatic and hydraulic power cylinder design.

We are used to devoting time and study to a proposal **even if no assurance of an order is there.**

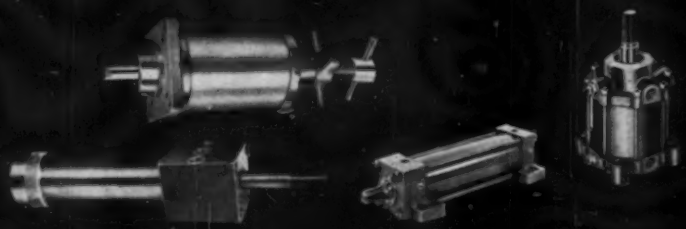
In most cases we can have a factory trained expert in cylinder design at your plant within hours from the time you call us — no matter where you are located or what your needs are.

Anker-Holth service is as close as your telephone. Phone Port Huron, YUkon 5-7181.

Users of standard cylinders: Find out about Anker-Holth's nine complete lines — the most diversified selection anywhere.

ANKER HOLTH

DIVISION, THE McDOWELL-WELLMAN COMPANIES



ANKER-HOLTH DIVISION
The Wellman Engineering Co.
2723 Connor St., Port Huron, Mich., U.S.A.

Please send me more information about Anker-Holth Cylinders

C-1

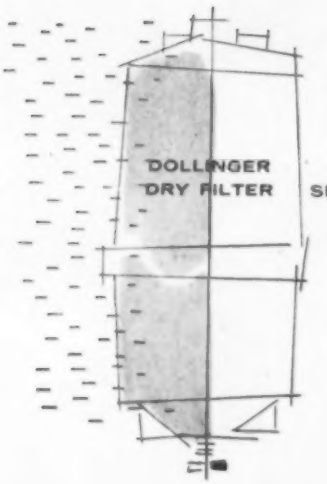
Name_____

Title_____

Company_____

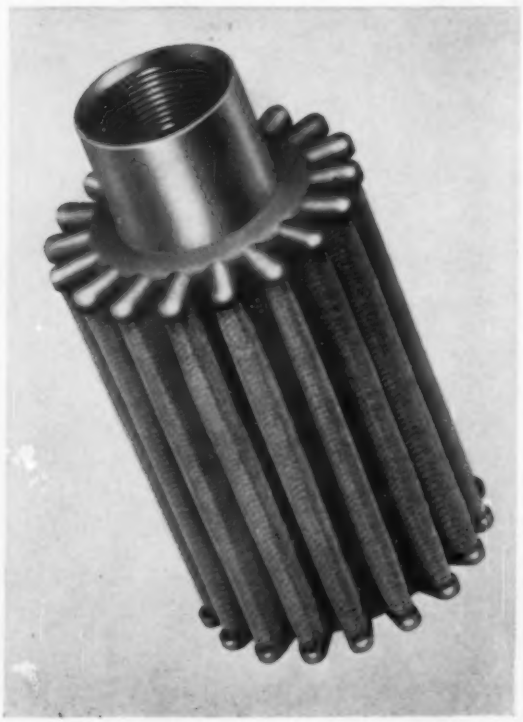
City_____

State_____



SPECIALISTS
FOR 39 YEARS

ALL NEW DESIGN...



Filters for Sump Pumps and Hydraulically Operated Equipment

AT A NEW LOW PRICE

Dollinger Sump Filters are priced lower than competitors' filters for the simple reason they have been specifically designed for your needs. Leading hydraulic equipment manufacturers have already standardized on these filters for their products.

Molded End Seals Reduce Cost

New method of manufacture results in lower production costs. Special plastic impervious to all synthetic oils, mild acids, coolants, and water to 300°F.

One Piece Construction

Positive protection against dirt, sludge, rust and abrasive particles causing pump failure.

Exclusive Radial Fin Design

Permits larger filter capacity in smaller area. Models are available in either 60 or 100 mesh screen depending on efficiency desired.

Eight standard sizes are available with capacities from 5 to 100 GPM. Get complete details; write for Sump Filter Bulletin 330. Dollinger Corporation, 65 Centre Park, Rochester 3, N.Y.

PROTECTOMOTOR U.S. PAT. NO.

STAYNEW FILTERS

DOLLINGER

LIQUID FILTERS • PIPE LINE FILTERS • INTAKE FILTERS HYDRAULIC FILTERS • ELECTROSTATIC FILTERS • MIST COLLECTORS • DRY PANEL FILTERS • SPECIAL DESIGN FILTERS • VISCOUS PANEL FILTERS • LOW PRESSURE FILTERS • HIGH PRESSURE FILTERS • AUTOMATIC VENTILATION FILTERS • NATURAL GAS FILTERS • SILENCER FILTERS

Barksdale AIR-SEAL* Valves for the nerve centers of production

** The air pressure is the sealing force; the higher the pressure, the tighter the seal.*

DIRECT SOLENOID 4-way, 3-way, shut-off and diverter valves

Standard **AC**

Explosion-proof **AC**

Standard **DC**

Explosion-proof **DC**

SOLENOID-PILOT 4-way and 3-way valves

Standard **AC**
Standard **DC**

Explosion-proof **AC**
Explosion-proof **DC**

MOMENTARY CONTACT solenoid-pilot valves

Single Solenoid

Both types available in standard AC and DC and explosion-proof AC and DC.

Dual Solenoid

MANUAL OVERRIDES for standard solenoid-pilot valves

"L" type manual override

"MK" type manual override

MANUAL and FOOT OPERATED valves

Manual 4-way

Manual shut-off

Foot operated 4-way

Write for air valve catalog (AV-9) which contains complete data and prices on 562 different valves (not counting voltage variations).

CONTROL VALVE DIVISION

Barksdale valves

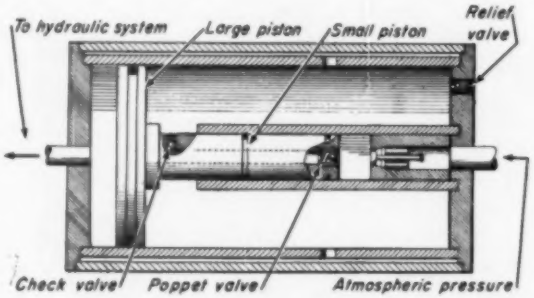
5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA

Circle **21** on Time-Saver Card

FLUID POWER PATENTS

the piston to the right. This motion compresses air trapped behind both pistons. The air trapped behind the small piston is forced through two check valves in the piston and into the chamber behind the large piston.

As oil is forced out of the accumulator, the piston assembly moves left. This motion reduces the pressure



behind the small piston. Atmospheric pressure lifts the poppet valve and replenishes the air behind the small piston.

Each time the accumulator operates, air is pumped into the main pressure chamber. A spring-loaded relief valve prevents pressure from rising above a set value.

The pistons are housed in a double shell cylinder. Air pressure is equalized on both sides of the inner shell to prevent distortion from internal pressure.

U. S. Patent 2,891,564 *by J. R. Jeromson, Jr., assigned to Thompson-Ramo-Wooldridge Corp., Cleveland, Ohio.*

Other Patents Issued

HYDRAULIC MOTOR CONTROL

No. 2,884,904 *by Carroll G. Gorden assigned to Fletcher Aviation Corp., Rosemead, Calif.*

SERVO-MECHANISM

No. 2,884,907 *by Raymond D. Atchley, assigned to Raymond D. Atchley, Inc., Los Angeles, Calif.*

PRESSURE OPERATED VALVE

No. 2,885,173 *by Herbert O. Dobrick, assigned to Bendix Aviation Corp., Teterboro, N. J.*

ELECTRO-HYDRAULIC SERVO VALVE

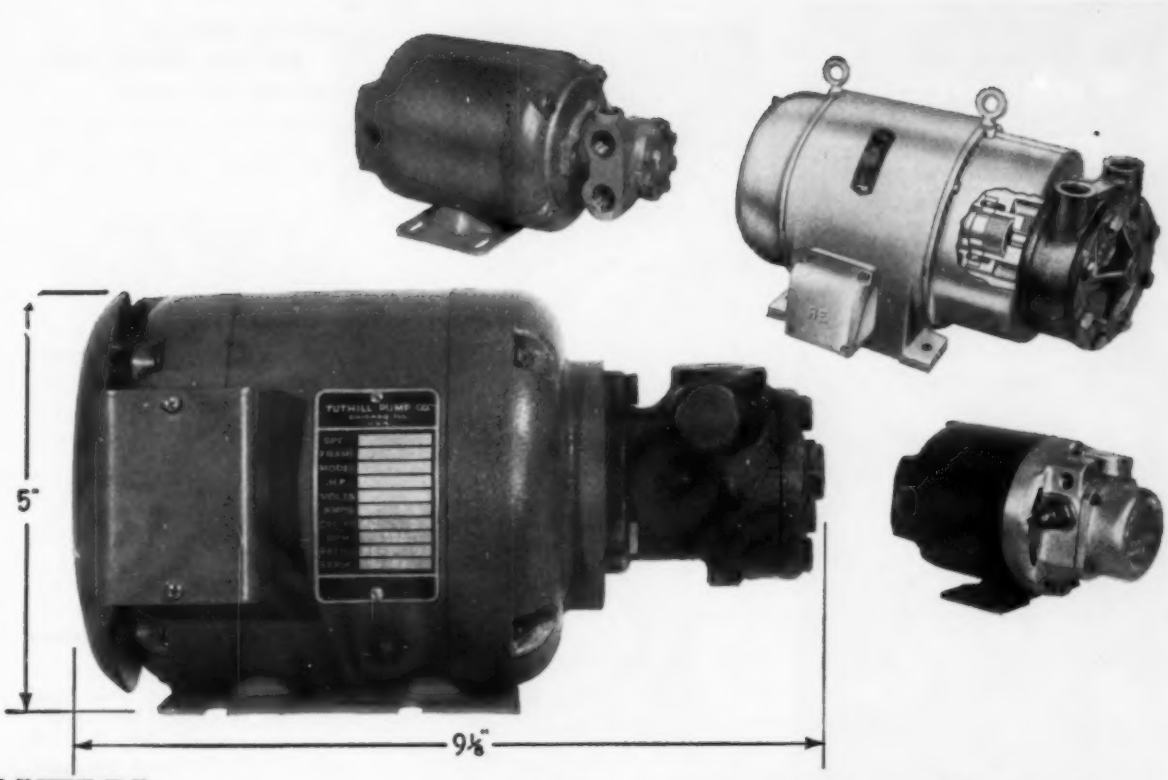
No. 2,886,009 *by Samuel A. Meyers, assigned to Northrop Aircraft Inc., Hawthorne, Calif.*

ACCUMULATOR CONSTRUCTION

No. 2,886,064 *by Jean Mercier, New York, N. Y.*

VARIABLE RESTRICTOR VALVE

No. 2,886,065 *by Gordon L. Hershman, assigned to International Harvester Co., New Jersey.*



NEW pump & motor combination

adds to TUTHILL'S complete close-coupled line

The new Series 42 shown above further extends Tuthill's complete line of close coupled pump and motor units. These compact combinations have been especially developed to solve design problems and cut costs in hydraulic, oil burning, lubrication and a wide variety of other services.

As shown above, this compact new unit has overall measurements of only 9⅛" by 5". The totally enclosed motor is supplied with ratings of from 1/12 to 1/6 hp, while the pump units have a capacity of 1/3 to 3 gpm. The Series 42 may be supplied either with or without a built in relief valve.

Some other models in Tuthill's line of close coupled combinations are also shown above. These include a broad selection of units with capacities up to 50 gpm, for pressures to 500 psi.

Save space, weight and money

The compact design of these units solves tough design problems. The elimination of couplings, bases and adapters results in significant savings. The reduction of weight lowers shipping costs. And their compactness often simplifies assembly operations for further savings in production costs.

Available from stock

All the units shown above, plus many others are immediately available from stock. There is no minimum quantity requirement . . . so you can use these economical units in a wide variety of applications.

"POWERMITE" for OEM applications

For original equipment applications involving substantial production runs, Tuthill offers further savings in space and weight through the use of the POWERMITE. This is an exclusive Tuthill design in which pump and motor are incorporated into one unit, which takes up no more space and weighs no more than a conventional motor. For example, the Powermite shown at lower right above, measures only 8 1/6" by 4¾" . . . has a capacity of 16 gph at 350 psi.

Tuthill's engineers will be happy to develop a Powermite specifically designed for your OEM application . . . providing the greatest possible saving in space and weight.

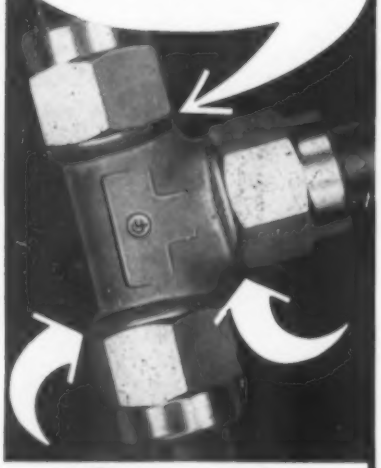
If you are trying to incorporate a pump and a motor into a limited space Tuthill has the answer. An experienced Tuthill field engineer will be happy to give you the details. Write today.

Tuthill manufactures a complete line of positive displacement rotary pumps in capacities from 1/3 to 200 GPM; for pressures to 1500 PSI; speeds to 3600 RPM.

TUTHILL PUMP COMPANY

981 East 95th Street, Chicago 19, Illinois

THE NEW
Rubbernek
FLARELESS
FITTINGS
GIVE YOU
POSITIVE STOP



Rubbernek's
POSITIVE STOP prevents over or under torqueing! Assures proper compression of the cushion seal unit. Rubbernek is pressure tight at extreme vacuum and leakproof at high pressures. Can be reconnected repeatedly without impairing sealing qualities, Rubbernek gives perfect and time-saving installations every time. Conforms to JIC standards, exceeds MIL-F-5506-A requirements. Specify Rubbernek *and save!* Save on first cost, save assembly time, save production dollars!

The cushion unit of Rubbernek prevents metal to metal contact of tube and connector . . . absorbs shock, vibration, and pressure surges. Factory assembled unit speeds installation.

We invite you to test Rubbernek under your most critical conditions

CHICAGO FORGING
& MANUFACTURING CO.
2004-A SOUTHPORT AVENUE
CHICAGO 14, ILLINOIS

Circle **30** on Time-Saver Card

NEW PRODUCTS

Continued from page 48

PIPE JOINT COMPOUND
. . . in vinyl tubes

Designation: Plastic Lead Seal

Features: Tubes contain 1 oz. of compound. Designed for installation, conversion kits of original

equipment manufacturers. Prevents seizing and galling, yet remains plastic.

Specifications: Temperature range to 550 F; pressure, to 6000 psi.

Crane Packing Co.
Morton Grove, Ill.

Circle **305** on Time-Saver Card

SOLENOID VALVES
. . . are full-ported

Designation: 30,000 Series

Features: Full-ported, direct lift valves provide reliable operation regardless of line pressures. Positive operation over entire range.

Specifications: Range is 0-3000 psi. Port sizes from ¼" to 3". Available in bronze or stainless steel.

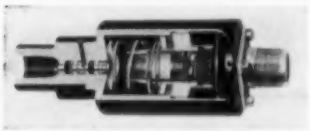
Atkomatic Valve Co.
Indianapolis, Ind.

Circle **306** on Time-Saver Card

PRESSURE SWITCH
. . . qualified 100,000 cycles

Designation: 95000 Series

Features: Piston actuates snap—action switch mechanism. Spring-loaded against system pressure.



High overload pressure bottoms piston, closes off switching element. Sealed from atmosphere.

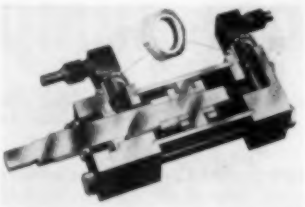
Specifications: Operates in systems to 4000 psi.

Hydraulic Research & Mfg. Co.
Burbank, Calif.

Circle **307** on Time-Saver Card

PORT SEALS
. . . for power cylinders

Features: For perfect sealing, quick positioning, protection from overtightening. Hexagonal steel threaded nut has threaded Teflon sealing insert. To install: thread seal hand-tight onto pipe or fitting; thread



fitting at least three turns into cylinder port; position fitting; with light to medium wrench torque, tighten port seal against cylinder port shoulder. No pipe dope compounds needed.

Miller Fluid Power Div.
Flick-Reedy Corp.
Bensenville, Ill.

Circle **308** on Time-Saver Card

HYDRAULIC FEEDS
. . . are self-contained

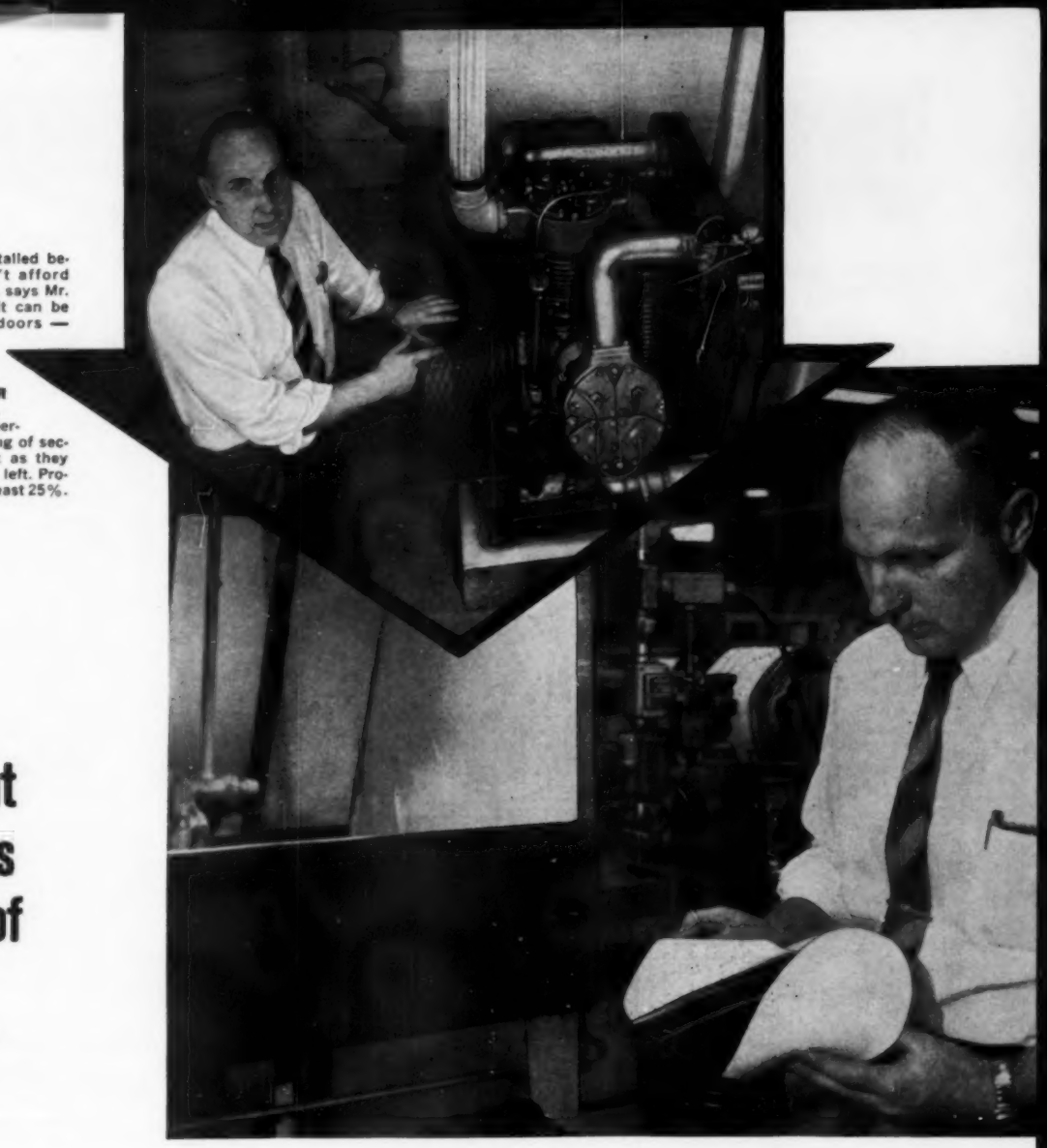
Features: Hydraulic drill press feeds automate presses with capacities to 1½" in steel. Unit has power transmission arm and console which houses control valves, hydraulic tank, and pump. Solenoid valve operated. Two general sizes available. Each feed tailored to press and work.

Beckett-Harcum Co., Inc.
Wilmington, Ohio

Circle **309** on Time-Saver Card

Continued on page 114

Circle **74** →



LE ROI 50S2 was installed because Bowes couldn't afford compressor downtime, says Mr. LaFara. Air-cooled unit can be used indoors or outdoors — needs no plumbing.

FINISHED TIRE REPAIR SECTION is inspected. Compressed air now permits automatic spraying of sections with liquid latex as they pass through booth at left. Production increased at least 25%.

This plant minimizes the risk of "no air - no work" with a

LE ROI 50HP STATIONARY COMPRESSOR

A dependable compressor headed the list of critical needs when Bowes Seal Fast Corp., of Indianapolis, Ind., merged two plants under one roof. A Le Roi 50S2 two-stage compressor provides this vital dependability . . . and all the compressed air needed to produce over 2000 various items for the upkeep of cars, tires, and tubes.

James S. LaFara, Plant Manager, reports that the Le Roi unit delivers 210 cfm at 125 psi . . . operates 75% to 80% of 8- to 16-hour production days, five days a week, and supplies almost 100% of all the compressed air needed. Down-time, he adds, is at a minimum, and maintenance costs are below those of two smaller compressors which the Le Roi replaced, and which now serve only as standby units.

Look what this Le Roi 50S2 does! It provides air to spray tire-repair sections (boots) and tubeless-tire repair plugs with a mixture of liquid soap and water. The unit powers latex spraying machines, and blows scraps from tube-patch cutting machines. Other uses include air for lead moulding equipment, nut-driving units, cleaning vents on chemical filling machines, and for the plant's fire-protection system.

Are you looking for a "dependable" compressor? Check the complete line of Westinghouse unit-type and Le Roi stationary air compressors — from ½ to 100 hp. Contact your Le Roi distributor, or write to Le Roi Division, Westinghouse Air Brake Co., Milwaukee 1, Wisconsin.

S2-68

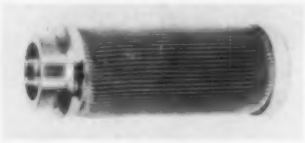
LE ROI STATIONARY COMPRESSORS

PORTABLE AND TRACTAIR® AIR COMPRESSORS • STATIONARY AIR COMPRESSORS • AIR TOOLS

NEW PRODUCTS

HIGH TEMPERATURE FILTERS
. . . are pressure locked

Features: High pressure process locks together media, end caps, and center tube. Filter medium embedded in end caps for leakproof seal. Since units are not welded, aluminum and dissimilar metals can be used. No oxidation product contamination. No carbide precipitation. Filter any hydraulic fluid. Stainless steel wire mesh elements.



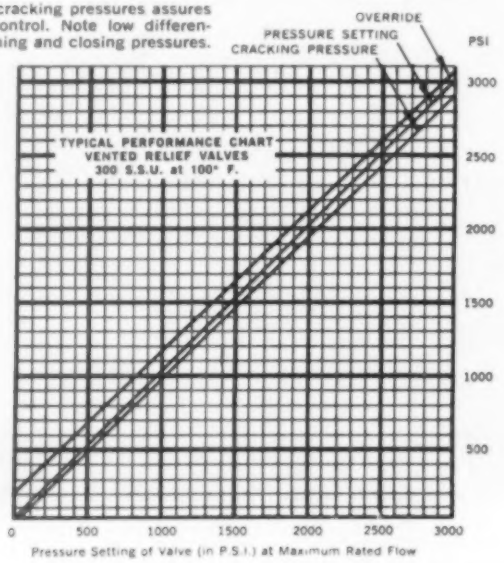
Specifications: Element applications to 1000 F (limited by housing components). Elements in 1"-1¾" diameters. Nominal 5, 10 micron ratings. Capacities: ½, 3, 6, 12 gpm.

Purolator Products, Inc.
Rahway, N. J.

Circle **310** on Time-Saver Card

Take A Long, Close Look
AT THE NEW H-P-M RELIEF VALVES

Close control of cracking pressures assures accurate cycle control. Note low differential between opening and closing pressures.



The performance chart tells the complete story: Close control of cracking pressures; choice of high or low venting pressures to match your system requirements; low override for system protection and trouble-free operation. They're interchangeable with industry standards. Available in ⅜", ¾" and 1¼" sizes, subplate mounted, 3000 psi, 0 to 65 gpm.
THE PRICES ARE COMPETITIVE.

⅜" Relief Valve
3000 psi, 6 gpm

¾" Relief Valve
3000 psi, 20 gpm

1¼" Relief Valve
3000 psi, 65 gpm

HPM

H53

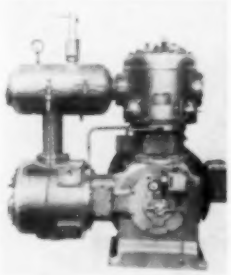
THE HYDRAULIC PRESS MFG. COMPANY
A Division of Koehring Company, Mount Gilead, Ohio, U.S.A.

Circle **65** on Time-Saver Card

LOW PRESSURE COMPRESSORS
. . . in three models

Designation: AA series.

Features: Water-cooled, double-acting, single-stage. Have two cylinders of equal size. Pulsation dampers replace intercoolers.



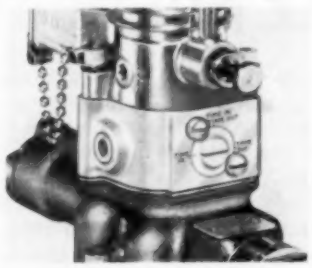
Specifications: Deliver 372-1430 cfm at pressures to 45 psi. Weight: 3100-6400 lb. Cooling water requirements: 162½-475 gph.

Atlas Copco
New York, N. Y.

Circle **311** on Time-Saver Card

TIMING SEQUENCE HEAD
. . . times in, out, or both

Features: Eliminates timers and relays to delay valve function. Delays function from 0 to 30 sec. Delay extended to minutes by connecting accessory reservoir to head port. Metering pin in side of head sets



interval. Repeatability within 2%. Valve function can be changed without disassembly of valve or head, and with line pressure on unit: Loosen lock screws, turn indicating plate to function mark, tighten lock screws. Two types: for direct mounting between pilot and

Continued on page 116

All Marine and Military Specification "O" RINGS ready for immediate shipment

All Sizes and Quantities of Viton, Butyl, Teflon and Silicone Now in Stock.

A tremendous inventory of all Military Spec as well as standard quality "O" Rings is now carried by Bearings, Inc. in order that we may be able to meet all customer requirements without delay.

Prices are competitive with other sources and with our automatic packaging equipment we can package to Military Specifications or individual requirements. We can also supply "O" Rings as "cure-date" kits. Inquiries for your immediate needs or for a year's requirements will be answered promptly. Write or call NOW!

All Bearings, Inc. specification "O" Rings are source inspected and shipped from Navy certified stock to qualified buyers.

Providing bearing service in the North ➤ **BEARINGS, INC.**

OHIO: Akron • Canton • Cincinnati • Cleveland • Columbus • Dayton • Elyria • Hamilton • Lima • Lockland • Mansfield • Painesville • Toledo • Youngstown Zanesville • **INDIANA:** Ft. Wayne • Indianapolis • Muncie • Terre Haute • **PENNSYLVANIA:** Erie • Johnstown • Philadelphia • Pittsburgh • York **WEST VIRGINIA:** Charleston • Huntington • Parkersburg • Wheeling • **NEW JERSEY:** Camden **NEW YORK:** Bolanrol Corp., Buffalo • Niagara Falls • **MARYLAND:** Baltimore • **DELAWARE:** Wilmington

and

in the South ➤ **DIXIE BEARINGS, INC.**

FLORIDA: Jacksonville • **GEORGIA:** Atlanta • **KENTUCKY:** Louisville • **LOUISIANA:** Baton Rouge • New Orleans **N. CAROLINA:** Charlotte • Greensboro • **S. CAROLINA:** Greenville • **TENNESSEE:** Chattanooga • Kingsport • Knoxville • Nashville **VIRGINIA:** Norfolk • Richmond

NEW PRODUCTS

valve body; and for direct mounting on valve body, with remote pilot control.

Specifications: Adds 1¼" to height of valve assembly.

Valvair Corp.
Akron, Ohio

Circle **312** on Time-Saver Card

ROTARY VALVE ACTUATOR
. . . slips on valve stem

Designation: SM-11

Features: Controls hydraulic valves. Low rotor inertia. Optional: tachometer, tachometer feedback, magnetic brake, potentiometer, limit switches. Gear trains fully enclosed and lubricated. May be pushbutton controlled from 115 v, 60 cps, or furnished with dial-type remote positioner. Printed circuit amplifier drives motor control phase from last stage power transistors. Unit is suitable for panel or machine-frame mounting.

Specifications: Diameter is 4½"; length, 5". Develops 125-lb. in. torque. Full-scale control in a second. Remote control accuracies of .001. Acceptable signals include 3-15-psi air, .5-5 ma.

Jordan Controls, Inc.
Milwaukee, Wis.

Circle **313** on Time-Saver Card

ON THE JOB...
with CROSS
HYDRAULIC CYLINDERS
Stay "on the job" with dependable, rugged Cross Hydraulic Cylinders. Like Cross customers everywhere, you too, will appreciate the fast, courteous, dependable service you get from Cross. Phone for speedy delivery on any quantity...quality-built to your specifications. Contact Cross Engineering Department, today!
■ RUGGED
■ DEPENDABLE
■ ECONOMICAL
CUSTOM DESIGNED CYLINDERS FOR EVERY APPLICATION
Try CROSS CYLINDERS in your operation... low cost, dependable, and trouble free.
Lowest-Priced Engineered Quality Cylinders Available..
trade mark of Quality in Hydraulic Cylinders...
HYDRAULIC CROSS CYLINDERS
CROSS MANUFACTURING CO.
LEWIS, KANSAS – PHONE EA 4-5525
WRITE • WIRE • PHONE...TODAY!!

Circle **37** on Time-Saver Card

VANE PUMP
. . . has 4-position cover

Designation: Series 45

Features: Positive vane tracking. Highly efficient. All wear parts are in cartridge which can be replaced in less than 10 minutes. No need to remove pump from housing.

Specifications: Interchangeable cartridges deliver 52, 63, 75 gpm at 2000 psi. At SAE rating (1200 rpm, 100 psi), deliver 34, 41, 48 gpm.

Vickers, Inc.
Marine & Ordnance Dept.
Waterbury, Conn.

Circle **314** on Time-Saver Card

4-WAY SOLENOID VALVE
. . . in over 100 variations

Designation: Series A

Features: Single or double solenoid. Options include hydraulic adapters, integral junction boxes, manual

override, threaded exhaust blocks, built-in speed controls. Anti-extrusion O-ring arrangement. Various mounting brackets for side-ported models. These models can be pipe-mounted to equipment. Manifold

Continued on page 118

Circle **28** on Time-Saver Card

HYDRAULIC ENGINEERING FOR INDUSTRY

CARDWELL

TRADEMARK SINCE 1829

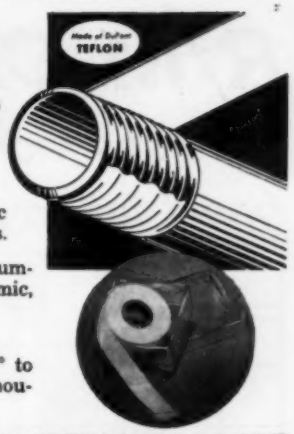
DESIGN SERVICES
FABRICATION
POWER UNITS
HYDRAULIC PANELS
ELECTRICAL CONTROL PANELS
ACCUMULATORS
STOCKING DISTRIBUTORS
HYDRAULIC COMPONENTS

Complete Engineering and Design Services Are Available. Qualified Sales and Service Engineers in Most Areas.

The **CARDWELL** MACHINE COMPANY
Quality – A CARDWELL TRADITION SINCE 1829
Franklin at 19th St., Richmond 11, Virginia • Phone Milton 4-4593

Circle **35** on Time-Saver Card

New Sealer THRED-TAPE



SEALS ANYTHING: chemicals, corrosives, hydraulic fluids, Freon 22, aromatic fuels, solvents, toxics, gases.

ALL TYPES OF PIPE: plastic, aluminum, stainless steel, ceramic, synthetic rubber, carbon.

ALL THREADED CONNECTIONS Temperature range −250° to +500°F., pressures to thousands of pounds.

EASY TO USE

Just cut to length and wrap tightly around pipe. Press overlap to secure and make connection in usual fashion. No mess.

Available in ½" x 288" rolls, packaged in a protective, clear plastic box.

Request sample and full information.

Utah Crane CRANE PACKING COMPANY

6405 OAKTON STREET, MORTON GROVE, ILLINOIS *(Chicago Suburb)*
In Canada: Crane Packing Co., Ltd., Hamilton, Ontario

DRAGON

SPECIALISTS IN NEEDLE VALVES

VALVES FOR...
- Liquid Gases
- Remote Control
- Corrosive Fluids
- Hydraulic Systems
- Pneumatic Systems

WIDE RANGE OF SPECS...
- Vacuum to 30,000 psi
- −320°F to +1200°F
- ⅛" thru 1" in NPT & AND-10050 Tubing Ends
- Made from Carbon Steel, 4140, Monel, Aluminum, Brass, and Stainless in types 303, 304, 316, 321, 347, 416, and Alloy 20
- Teflon & other packings
- Panel Mountings
- Manual and Air Operated
- Send for catalog

Dealers in All Major Cities

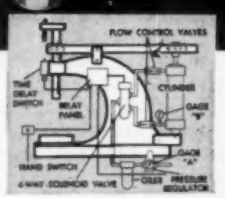
DRAGON
ENGINEERING CO., INC.
P. O. BOX 185
NORWALK, CALIF.

Circle **130** on Time-Saver Card

PNEU-TROL

AUTOMATION TIME DELAY SWITCH

FOR CONTROLLED TIME DWELL OF AIR OR HYDRAULIC CYLINDERS



Arbor press converted to high production power press, using double end cylinder, Time Delay Switch, Flow Control Valves, and related equipment. Flow Valves permit independent ram speed adjustment in both directions. Differential pressure between "A" and "B" gages caused by throttling effect of Flow Control Valve creates time interval in working pressure build-up, which is compensated for by Time Delay Switch setting. This insures consistently accurate working pressure on the ram.

- Holds dwell accurately to fraction of second
- Automatically re-sets
- Designed for millions of actuations

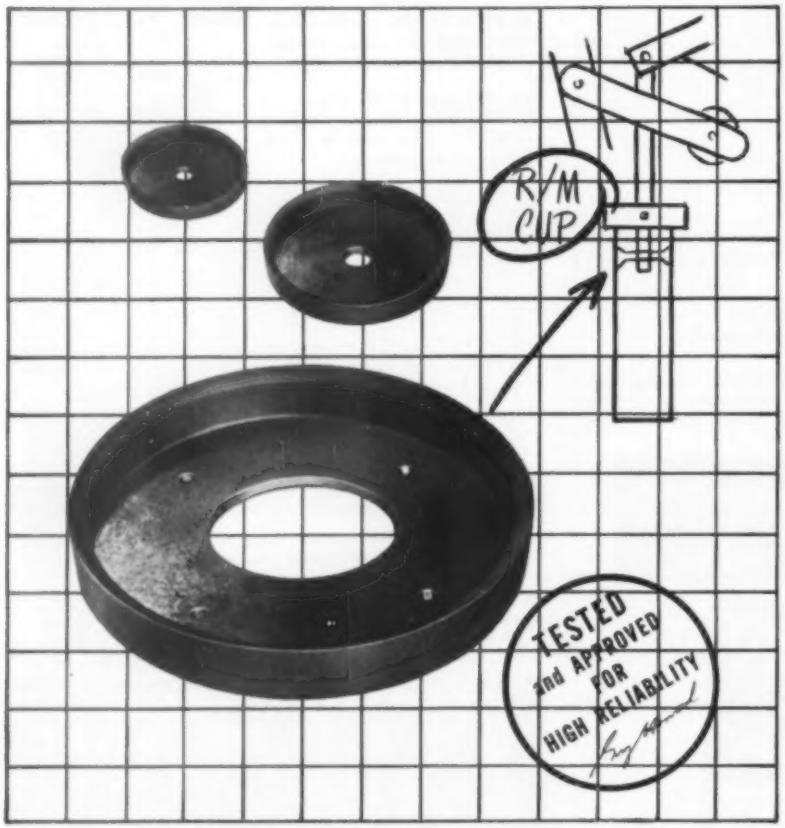
Pneu-Trol Time Delay Switch will hold any cylinder controlled motion or operation at a positive stop on either end of the stroke for ¼ to 60 seconds in 20 to 1 ratios. Simple, easy to adjust. Automatically re-sets after each actuation. Positive, controlled time dwell permits wider use of air or hydraulic power in automatic operations, increases accuracy of work by insuring split-second accuracy of time dwell. Available with many thrust linkages for left and right, down, up, or horizontal thrust. Write for Special Bulletin TDS-59

AUTOMATION AUTO-PONENTS INC
2919 GRANT STREET
BELLWOOD (Chicago Suburb) ILLINOIS

Circle **15** on Time-Saver Card

R/M CAPABILITY

develops industry's finest fabric piston cups



R/M Fabric Piston Cups are all examples of R/M's high capability in the packing field and application of these skills to industry's growing demands. They are designed and precision molded for minimum friction and high resistance to extrusion. R/M chemists and engineers have developed a wide range of rubber synthetics with fabric reinforcements so as to provide materials to meet any requirement. Accurate and carefully controlled molding of the cups assures dimensional uniformity and maximum sealing efficiency.

R/M Fabric Piston Cups fit hydraulic and pneumatic cylinders ranging from ½ to 12 in. in diameter. They are molded in varying degrees of hardness to withstand pressures up to 1500 psi. When ordering, specify type of equipment, constant or intermittent service, type of fluid, temperature range, pressure and speed range.

For complete data, including service recommendations, write for R/M Mechanical Packings and Gasket Materials Bulletin No. P-210C. In it you will find R/M piston cups to suit your most exacting requirements.

R/M **PACKINGS**

RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N. J.
MECHANICAL PACKINGS AND GASKET MATERIALS

Circle **95** on Time-Saver Card

NEW PRODUCTS

mount models bolt to manifold plate.

Specifications. For 40-300 psi, air or oil. 3/16" diameter flow area. Single solenoid model is 5-1/4" high x 1-5/8" diameter; double solenoid, 8" x 1-5/8". Average weight less than 2 lb.

Versa Products Co., Inc.
Englewood, N. J.

Circle **315** on Time-Saver Card

AIR CONTROL
. . . has ±.25-psi repeatability

Designation: Mite 74

Features: For pressure limit protection. Has integral 3-way valve. Automatically trips on decreasing instrument air signal, to vent or lock downstream air. After signal

pressure is restored, can be reset to 10% above trip setting. Can be tripped from remote point, or tripped automatically when signal exceeds predetermined pressure.

Specifications: Trip point adjustable from 1 to 100 psig.

George W. Dahl Co., Inc.
Bristol, R. I.

Circle **316** on Time-Saver Card

ENCLOSED SWITCH
. . . has 2-way actuator

Features: SPDT snap-acting switch in die-cast aluminum housing. Sealed overtravel plunger. Adjustable roller-lever actuator for fast or slow cams or slides. Actuator arm adjusts through 240 deg. around shaft. Actuator bracket rotates about plunger, locks in 8 positions, 45 deg. apart. Neoprene boot sealed to plunger. Wiring connections made

with switch outside metal case. One-base, two-base mounting.

Specifications: Switch listed at 20 amp., 125, 250, 480 vac. Horsepower ratings are ¾ hp, 125 vac, 1½ hp, 250 vac.

Unimax Switch
Div. W. L. Maxson Corp.
Wallingford, Conn.

Circle **317** on Time-Saver Card

SOLENOID PILOT VALVES . . . replace air pilot valves

Features: Valves mount with pressure-applied and pressure-release valves, replacing pilot air end caps. Mounting lugs are integral part of body. Valve can mount on machined face.

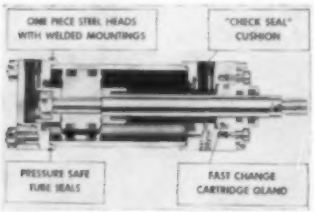
Holman Brothers, Ltd.
Camborne, England

Circle **318** on Time-Saver Card

LOW-PRESSURE CYLINDERS . . . for air & oil

Designation: Powrmation

Features: Variety of mountings, rod diameters, rod ends. Strokes to any practical length. Extra-long bearing with optional gland eliminates internal spacers in many long-stroke cylinders. Packings for various temperature ranges, and fire-resistant



fluids. Mountings welded to one-piece steel heads. Vibration can't loosen. Positive seal on tube's OD. O-ring doesn't extrude. Check seal cushion minimizes destructive effects of heavy or high-speed loads.

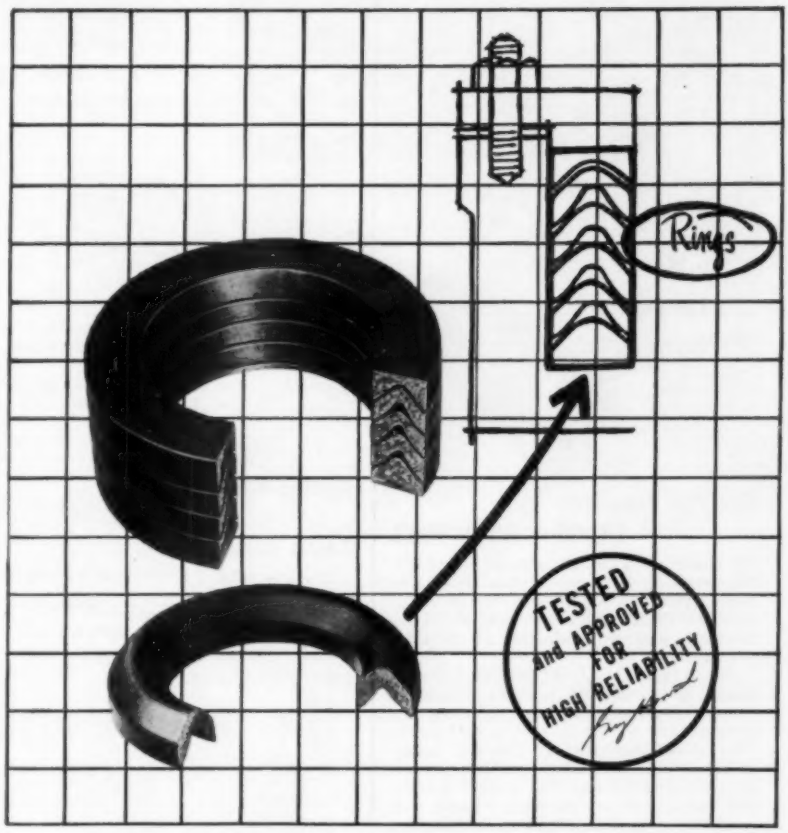
Hanna Engineering Works
Chicago, Ill.

Circle **319** on Time-Saver Card

Continued on next page

R/M CAPABILITY

developed industry's finest V-ring—Vee-Flex®



Because of exceptional capability in the packing field, R/M is widely regarded as the surest source for the solution of difficult packing problems.

One example is development of R/M Vee-Flex. Self-sealing, self-adjusting, it is the *original* convex-design hydraulic V-ring. Its surface has a convex curvature where it contacts the ring adjacent. On the pressure stroke, an automatic flexing action occurs, producing a positive seal against the shaft and stuffing box wall, and against the next ring as well.

Deep, thorough penetration of the compound into the fabric of this quality packing enables it to provide maximum resistance to extrusion at high pressures. This, plus rock-hard adapter rings, makes it possible for Vee-Flex to withstand pressures in excess of 6000 psi without extruding. And the problem of wicking action is eliminated.

Specify tough, positive-sealing R/M Vee-Flex Packing for long, trouble-free service on all your piston and rod applications. For complete data, write for the R/M Vee-Flex Bulletin.

R/M **PACKINGS**
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N. J.
MECHANICAL PACKINGS AND GASKET MATERIALS

Circle **96** on Time-Saver Card

O-M PRECISION

GIVES CYLINDERS GREATER EFFICIENCY and DEPENDABILITY

Meets JIC Standards

Fits Where Others Won't

By machining to micrometer accuracy the working surfaces within O-M Air and Hydraulic Cylinders, these units function with high operational effectiveness and a minimum of routine maintenance.

More than this, O-M precision workmanship is reflected in every engineering and construction detail. These components are designed right to seal right. The ports are readily rotated independently to a desired location. Accurate machining assures perfect piston rod alignment on extreme in and out positions, on maximum or minimum loads as well as on short or long travel.

O-M standard, oversize and 2 to 1 rods have a high yield point that increases fatigue strength. The low coefficient of friction and cushion ball-check valve provide for full-power starts. End plugs are tapped for universal mounting.

Series 101A (illustrated) and Series TH (Heavy-duty Hydraulic Cylinder) are available in a complete range of sizes (½" to 8" bores) and a full line of mounting brackets. Immediate delivery on many sizes.

Mail coupon at once for Bulletins 101A and 105 containing engineering data on the two units.

ORTMAN-MILLER MACHINE CO.
1 143rd Street, Hammond, Indiana

☐ Have representative call
☐ Send Bulletins 101A and 105

Name_____ Position_____

Company_____

Address_____

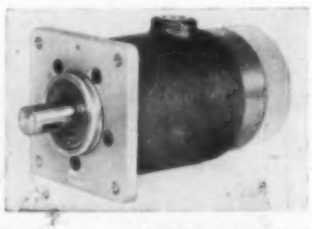
City_____ Zone____ State_____

Circle **88** on Time-Saver Card

NEW PRODUCTS

HIGH PRESSURE PUMPS
. . . to 4.2 gpm at 3000 psi

Features: Positive displacement, piston pumps are 90% efficient. Four bearings on 4½" of 6" shaft: ball, Timken, special ball thrust, Torrington. Field teardown in less than five minutes.



Specifications: Weight, 12½ lb., diameter, 3¾"; length, 8½".

Mark Hydraulic Co.
Omaha, Nebraska

Circle **320** on Time-Saver Card

HAND PUMP
. . . has cartridge valve

Features: Single-acting. Release valve in front. Wearing parts accessible. To service cartridge valve, remove O-ring-sealed plugs.

Specifications: For 1000, 2500, 5000 psi. Displaces .9, .4, .17 cu. in./stroke. 60-cu. in. reservoir may be pressurized to 80 psi.

Sheffer Corp.
Cincinnati, Ohio

Circle **321** on Time-Saver Card

ENCLOSED SWITCHES
. . . with new actuators

Features: One-way roller arm and rod actuator versions of E6 and V6 enclosed switches. For either side or bottom mounting. Sealed plunger protects actuating mechanism and switching unit. 6" rod actuator for low force. Both types field adjustable horizontally and vertically. SPDT.

Specifications: 15 amp, 120, 240, 480 v ac; ½ amp., 125 v ac; ¼ amp, 250 v ac

Micro Switch Div.
Minneapolis-Honeywell Regulator Co.
Freeport, Ill.

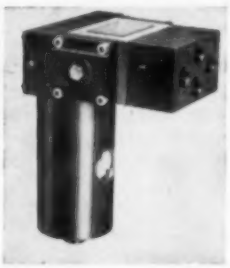
Circle **322** on Time-Saver Card

HYDRAULIC TRACER VALVE
. . . for any machine tool

Designation: Models TC-320, TC-340

Features: Probe has hydraulic servovalve. Designed for single-axis tracing.

Specifications: Probe stable at 200-3000 psi. Temperature range from 60 to 120 F. Ratings at 1000 psi: TC-320, 5 gpm capacity, flow rate



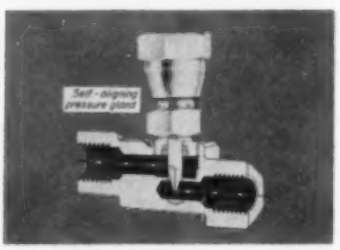
of 1 gpm per .001" stylus deflection; TC-340, 10 gpm capacity, flow rate of 2 gpm per .001" stylus deflection. Solenoid deenergize retract is available.

Tracer Control Co.
Hazel Park, Mich.

Circle **323** on Time-Saver Card

NEEDLE VALVES
. . . have special needles

Features: Vernier needle gives fine control. Needle with enlarged head for oversize openings produces

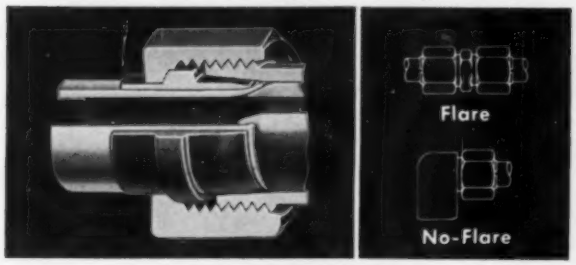


large-volume throttling action. Standard needles available. Seal in self-aligning pressure gland makes turning of needle easy under maximum pressure. Gland is close to

Continued on page 124

Circle **46** on Time-Saver Card

NOW! Get the advantages of both FLARE and NO-FLARE fittings with



FLODAR'S

Combination Self-Flare Tube Fittings

The Easy Installation Of A No-Flare Fitting — no time consuming flaring operation — no flaring tools required. Can be used with heavy-wall tubing and, provides a seal on the OD of the tube.

The Efficiency Of A Flare Fitting — Can be used on thin wall tubing — provides a seal on the ID of the tube.

- Easy Assembly — "Rock Bottom" stop signals that joint is sealed.
- Double Seal — seals on both OD and ID of the tube.
- Lower Cost — FLODAR'S Self-Flare fittings cost less to buy and install.

You gain the advantages of both flare and no-flare fittings with none of the disadvantages . . . when you switch to FLODAR Self-Flare tube fittings.

Tube shearing and work hardening are eliminated . . . FLODAR Self-Flaring fittings can be reassembled time after time without fear of leakage or damage to tube and fitting.

Priced competitively, this fitting is available in tube sizes from ⅛" to 2" and in steel, stainless, brass and aluminum.

Write for FLODAR Fitting Catalog.

FLODAR Corp.

16911 ST. CLAIR AVENUE • CLEVELAND 10, OHIO

Circle **105** on Time-Saver Card

Just Out! Just the ticket to cut cost!

ROSS CUB

CUB

NEW SPEED CONTROL VALVE

⅛" and ¼" pipe sizes in stock now!

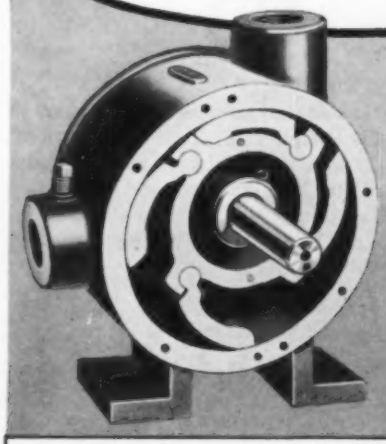
Now a speed control valve that regulates your cylinder movement with precision and sureness, but which lists at $3.00 and $3.25. And despite its lower costs, "CUB" features the same high quality of design and workmanship you've come to expect from Ross. "CUB'S" design stresses trouble-free operation and easy maintenance. CUB is small, aluminum and lightweight. If you use speed controls, by all means call your Ross representative or write us.

ROSS OPERATING VALVE CO.

105 E. Golden Gate Ave. • Detroit 3, Michigan

Here's why LEIMAN AIR PUMPS

Put "Lifetime" Dependability into your Machines!



HINGED, CURVED VANES OF DURABLE CAST IRON

Take up their own wear

Four curved vanes on easy-action hinges scoop up large volumes of air and maintain perfect cylinder wall contact by centrifugal force. Vanes and cylinders are made of durable cast iron (no composition). They hone themselves to hard, glassy smoothness, reducing frictional wear to a minimum. Negligible wear is automatically taken up by rotating vanes. 2 to 3 times more air space is provided.

Typical reports from users:

"Never wear out or give trouble"

"Used 350 pumps without a complaint"

"Pumping 24 hours a day for 21 years"

"12 years without any attention, except lubrication"

•

If the operation of your machines depends on a reliable, steady source of vacuum (suction) or air pressure—install Leiman Air Pumps. They will last for the life of your equipment—providing fully-rated capacity, year after year, with little or no maintenance.

The simplified design of Leiman Air Pumps has fewer moving parts—provides greater capacity in smaller pumps to compact your designs. Airflow is smooth—operation extremely quiet. A wide range of models and sizes is available to meet your operating conditions. Experienced engineers are at your service on any design or installation problem.

LEIMAN BROS., INC.
151 Christie St., Newark 5, N. J.
Established 1887

SEE OUR CATALOG IN SWEET'S FILE

Write for new catalog showing construction, types, sizes and specifications, plus Application Book containing many "how-to-do-it" blueprints.

LEIMAN Rotary Positive AIR PUMPS

Vacuum to 29.9" Hg. Pressure to 20 p.s.i.g. Volume to 162 c.f.m.

ENGINEERED PRODUCTS

for
Hydraulic-Pneumatic
Service

TOP EFFICIENCY WHERE FLUID POWER IS INVOLVED

Garlock Leather Cups actually tend to polish metal surfaces they contact. Provide good resistance to abrasion and wear . . . unmatched for tensile strength and toughness . . . low coefficient of friction, minimum cold flow. All sizes, shapes, designs available for wide variety of pressures, temperatures, non-caustic fluids. For more severe service conditions, rubber fabric-inserted cups are generally recommended. Catalog AD-145.

Garlock CHEVRON* Packings are as close to "frictionless" as you'll find. As pressures increase, the packing rings tighten to prevent leakage; with declining pressures, the rings ease off, permitting free operation of the rod, ram, or piston without leakage. Once installed, need no further adjustment to meet pressure variations. Available in many materials, including Teflon† for practically all applications. Catalog AD-115.

CHEMISEAL* Nylon Pressure Tubing by Garlock is the ideal answer for hydraulic and pneumatic lubrication, oil, and fuel lines and vacuum system connections. It resists fatigue, abrasion, impact . . . withstands temperatures from −60° F to +180° F and higher. 1000 and 2500 psi grades available, conforming to J.I.C. specs. You can flex it or bend it for greater design freedom, versatility. Catalog AD-171.

GARLOCK

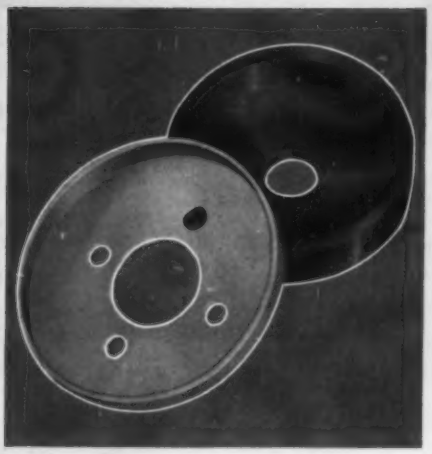
Take advantage of this "know-how" in the design field. Talk to your local Garlock representative at the nearest of our 26 sales offices and warehouses throughout the U.S. and Canada. Or, write The Garlock Packing Company, Palmyra, N.Y.

Canadian Div.: The Garlock Packing Company of Canada Ltd.

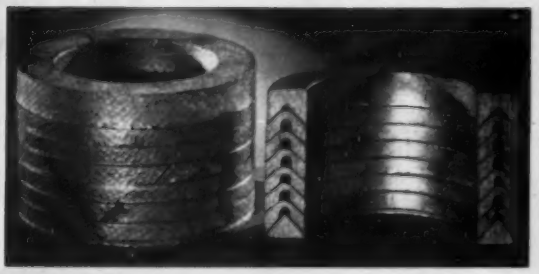
Plastics Div.: United States Gasket Company

Order from the Garlock 2,000 . . . two thousand different styles of Packings, Gaskets, Seals, Molded and Extruded Rubber, Plastic Products

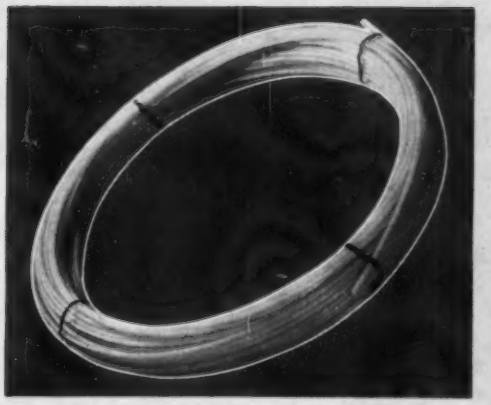
*Registered Trademark
†DuPont Trademark



LEATHER CUPS are naturally tougher than other materials . . . suitable for most applications. Fabric cups are recommended for severe service.



CHEVRON PACKINGS permit free operation with minimum friction at all pressures . . . last longer, need less maintenance.



CHEMISEAL NYLON PRESSURE TUBING is unaffected by solutions which corrode metal . . . costs less than metal . . . available from $\frac{1}{8}$" O.D. up.

NEW PRODUCTS

port. No trapped dirt or air around needle threads. Needle can't turn out of bonnet. Standard, dial, knob models.
In-line, panel mounting.
All internal parts stainless steel.

Specifications: Female dryseal pipe sizes: ⅛", ¼", ⅜", ½", ¾". Equivalent aeronautical tube sizes available. Operating pressures: aluminum, 3000 psi; steel, 5000 psi.

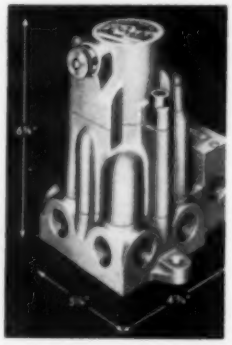
Auto-Ponents, Inc.
Bellwood, Ill.

Circle **324** on Time-Saver Card

AIR CONTROL VALVE . . . weighs 4 lb.

Designation: PDQ

Features: Can be replaced in less than 30 sec. To remove, loosen two cap screws, twist pilot cap, remove pilot cap and valve housing. Two self-contained replacement assemblies popper spindle-sleeve, and solenoid pilot. Short-stroke pilot, full —orifice poppet spindle. No tools



needed to repack in less than a minute.

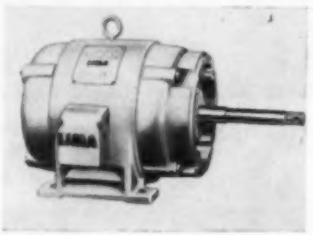
Specifications: ½" NPT valve flows 335 cfm with 100-psig initial pressure to atmosphere. Response time to fill 140-cu. in. vessel to 90 psig is .113 sec. To exhaust to 10 psig, .195 sec.

Hunt Valve Co.
Salem, Ohio

Circle **325** on Time-Saver Card

CLOSE-COUPLED PUMP MOTORS . . . in NEMA rerated frames

Features: Frames are rigid, seasoned cast iron. Integrally cast feet. Deep-drawn baffle plates in end bells protect winding. Connection boxes rotate for easy connecting. Die cast aluminum rotors have dual cooling fans. Entire rotor assembly



is dynamically balanced. Prelubricated, sealed ball bearings need no cleaning.

Specifications: Dripproof frames 182-405u: ½ hp at 900 rpm to 75 hp at 1800 rpm. Explosion-proof, totally enclosed fan-cooled frames 182-326 U: ½ hp at 900 rpm to 30 hp 2 or 3-phase. All frequencies and commercial voltages below 600 v.

Lima Electric Motor Co., Inc.
Lima, Ohio

Circle **326** on Time-Saver Card

Capital

HYDRAULIC FILTERS

for Hydraulic and Oil Re-circulating Machinery

Capital Hydraulic Filter Units are smaller than ordinary filters but with filtering capacity equal or superior to many larger filters. Small size permits greater latitude in design, particularly where space is restricted.

Capital Filter Units are designed with one-piece construction — no screws or nuts to work loose and be lost or mislaid. Simple and easy to clean by any method.

Made from specially designed woven Monel wire, with narrow corrugations presenting the greatest filtering area. Monel support supplies extra sturdiness.

Capital Filter Units are made in 4 Types:

- MONO-BILT 60 Mesh All Stainless Steel (Sump type).
- MONO-BILT Standard All Stainless Steel
- MONO-ECONO Mono-Bilt with Monel Metal Insert and Cadmium Plated Top and Bottom.
- LINE TYPE with Aluminum Housing and Mono-Bilt, one Piece Filter Unit.

Capital Line Type Filter

Built from Monel Metal they are impervious to rust and corrosion.

CAPITAL ENGINEERING & MFG. CORP.

5836 SOUTH ASHLAND AVENUE, CHICAGO 36, ILLINOIS

Circle **27** on Time-Saver Card

Circle **86** on Time-Saver Card

PUMPS

that offer a new approach to your design problems

BUILT-IN DIRECTIONAL CONTROL

Miniaturized in everything but power, Oil-Dyne pumps provide new economy and efficiency on standard hydraulic applications . . . make hydraulic actuation possible on applications never before feasible.

Oil-Dyne pumps simplify your design problems by eliminating external directional control valving . . . integral valving permits changing the direction of cylinder travel by simply reversing the motor. Pressures to 3,000 lbs. (5,000 lb. peaks); available with or without pressure switches and/or relief valves. Write for illustrated catalog.

PIONEERING MINIATURIZED HYDRAULIC ACTUATION

PUMPS • PRESSURE SWITCHES
CYLINDERS • VALVES • ACCESSORIES

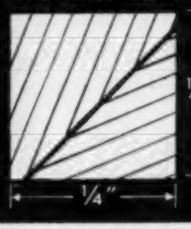
OIL-DYNE INC.
2115C West Marquette Rd., Chicago 36, Ill

Circle **14** on Time-Saver Card

PISTON LEAKAGE PROBLEMS ? ? ? CHANGE TO "STEP SEAL RINGS"

See the newest revolution in sealing rings by AUTO-DIESEL PISTON RING CO. The "STEP SEAL RING" has a sealing action over the entire area. This results in a ring that allows only ⅛ the leakage under 15 times the pressure of a straight cut ring—see comparison table below.

CROSS SECTION OF "STEP SEAL" JOINT



COMPARISON TABLE

STRAIGHT CUT COMPRESSION RING	"STEP SEAL RING"
With .005" end clearance has leakage rate of 150cc/min. at 400 lbs. pressure.	With .010"-.020" and .030" has a leakage rate of only 25cc/min. at 6000 lbs. pressure.

To reduce leakage to a minimum specify "STEP SEAL RING"

For complete details write for Bulletin H-57

THE AUTO-DIESEL PISTON RING CO.
3141 Superior Avenue • Cleveland 14, Ohio

AIR-MITE AIR CYLINDERS

★COMPACT ★POWERFUL ★RUGGED ★LOW COST

AIR-MITE Cylinders—made in Single or Double Acting Series, in 4 mounting types, are high quality cylinders at a low price. Simple, rugged design and compact construction give them long life, permit easy mounting on jigs, fixtures, tools, or machines. Used wherever power holding, pushing, pulling, or lifting is required, AIR-MITE Cylinders will meet your most exacting requirements of dependability and long life. Write for complete catalog and prices.

QUALITY FEATURES:
1. Ground and polished steel ram
2. Bronze oilless ram bushing
3. High strength aluminum alloy cylinder heads
4. Brass, true-bore cylinders
5. Five steel tie rods

02

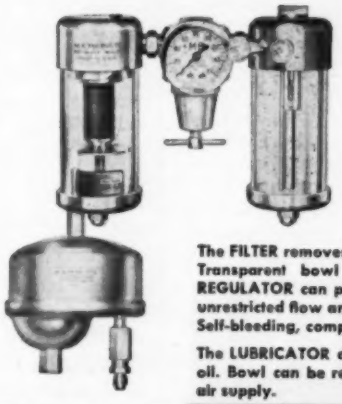
AIR-MITE DEVICES, INC.
4401 W. Kinzie St., Chicago 24, Ill.

Circle **6** on Time-Saver Card

GREATER PROTECTION to your AIR LINE!

M-B

WHIRL-A-WAY FILTER, REGULATOR AND LUBRICATOR ASSEMBLY AND AUTOMATIC AIR TRAP (MODEL W-4)



SUCCESSFULLY USED FOR PROTECTION OF AIR VALVES CYLINDERS CONTROLS PNEUMATIC TOOLS, ETC.

The FILTER removes solids .00039 and larger. Transparent bowl provides visibility. The REGULATOR can pass large volume with an unrestricted flow and minimum pressure drop. Self-bleeding, compact.

The LUBRICATOR delivers desired volume of oil. Bowl can be refilled without shutting off air supply.

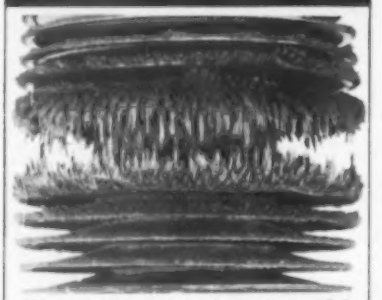
The Air Trap is automatic and eliminates manual draining.

M-B PRODUCTS
46 VICTOR AVE., Div. 12
DETROIT 3, MICHIGAN

Circle **77** on Time-Saver Card

meet a strainer with a magnetic personality

Ripley Magnetic Sump Strainers combine powerful built-in Alnico magnets with efficient, removable filter discs for 2 way protection—all in one compact unit!



The above section shows powerful magnetic attraction of the entire strainer assembly. Designed to meet J.I.C. Specifications for magnets in hydraulic systems . . . these Ripley Strainers require no extra openings in the reservoir, and disassemble for quick, easy cleaning. They are available now in a wide range of sizes. Write today for complete data!

RIPLEY

SCREEN AND STRAINER CO.

Filter Division

32749 Northwestern Hwy., Farmington, Mich.

Circle **100** on Time-Saver Card

USEFUL LITERATURE

Continued from page 54

CYLINDER NOMOGRAM

Nomogram for hydraulic cylinder design. Determines cylinder size for load, system pressure, and rod diameter. *Ground Systems, Inc., El Monte, Calif.*

Circle **414** on Time-Saver Card

VARIABLE SPEED HYDRAULIC TRANSMISSION

Maximum input speed is 725 rpm. Gives output speeds from input speed to 25 rpm. Can pick up loads from 0 rpm. Can be driven in either direction. Reverse drive of 5% input is available. Dustproof case acts as reservoir. Self-lubricating. Handwheel and remote electrical controls fitted at either side. Speed adjusts while stationary or running. Oil capacity is 18 gal.; weight, 2100 lb. Leaflet AL50/1. *Carter Gears Ltd., Bradford, Yorkshire, England.*

Circle **415** on Time-Saver Card

CRYOGENIC FLUIDS

Folding pocket card has tables of physical property equivalents of cryogenic fluids. Boiling and melting points, critical temperatures and pressures, volume, mass, thermal equivalents, and conversion factors. Has chart of cryogenic properties of gases. *Linde Co., Div. Union Carbide Corp., New York, N.Y.*

Circle **416** on Time-Saver Card

PRESSURE SWITCHES

Catalog covers line of pressure-actuated switches and sensing devices. Range is from 30" Hg to 12,000 psi. Includes new snap-action switch. Temperature range is —300 to 500 F. Withstands 40-50 g's at 2000 cps. 88 pages. *Meletron Corp., Los Angeles, Calif.*

Circle **417** on Time-Saver Card

MINIATURE VALVES

Valves are 1" x 1½". They control small cylinders, operate diaphragms, and pilot cylinders. Valve chambers in straight-through bore formed with aluminum spacers held rigidly in metal-to-metal end abutment. Spacers position and support O-rings. Stainless steel plungers are hollow, radially ported, ground, and polished. Bulletin 592 describes 3-way and 4-way valves: palm button operated; lever, ball actuated; pilot operated, spring-return; pilot-operated, bucking cylinder return; double pilot-operated. Dimensioned drawings, specifications. JIC symbols for each action. *Hunt Valve Co., Salem, Ohio.*

Circle **418** on Time-Saver Card

AIR LINE CONTROLS

Catalog on filters, regulators, lubricators, and drains. For quick service, each product is color-coded on cover, in table of contents, and

on inside pages. Catalog has line photos, functional data, description, explanation of operation, air flow diagrams, and specifications. Charts of loss of air pressure, water vapor and cfm. *Wilkerson Corp., Englewood, Colorado.*

Circle **419** on Time-Saver Card

BALL VALVE ELECTRIC OPERATORS

For valves in ¼"-4" size range. Weatherproof, vaporproof. Can be manually operated. Planetary gearing. Life exceeds 500,000 cycles. Data sheet includes drawings and dimensions, wiring diagram, temperature characteristics chart. *Jamesbury Corp., Worcester, Mass.*

Circle **420** on Time-Saver Card

RESEARCH LAB FACILITIES

Booklet outlines laboratory's applied research and development and testing capabilities. Mass pneumatic flow: air or inert gas flow to 2700 cfm; system static pressure, 0-250 psig; system temperature limits, 750 F continuous, 850 F intermittent. Compressed air system: Capacity, 40 lb./min.; temperature

Continued on page 129

Circle **5** on Time-Saver Card

BREATHER-FILTER

protects housings, crankcases, storage tanks.

The Air-Maze breather-filter keeps dust out of engine and compressor crankcases, gear-cases, hydraulic equipment, liquid storage tanks and machinery. Types and sizes available in both oil-wetted and oil bath models to protect every vented housing.

In the oil-wetted type, dust is impinged on a series of oil-wetted wire baffles. In the oil bath type, used where the dust concentration is unusually high, the filter media is enclosed in a bowl. Outside air must first pass through the oil, then the filter media, before entering crankcase or housing. Also functions as a backfire flame arrester.

Available in sizes from ⅛" to 3½". Permanent, all-metal, easily cleanable. Write for booklet BC-453. Air-Maze Corporation, Department AH-2, Cleveland 28, Ohio. (Subsidiary of ROCKWELL-STANDARD Corporation)

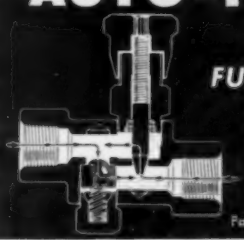
Circle **16** on Time-Saver Card

AUTO-PONENT®

HYDRAULIC FULL FLOW VALVES

Flow Control, Needle, Check, for HYDRAULIC Power

Model KF Flow Control Valve with Dial and Knob adjustment for direct reading and duplicating reference. Now available in Aluminum for 3000 psi.



Pat. #2,841,174

A complete line: ⅛", ¼", ⅜", ½", and ¾" female Dryseal Pipe Sizes in all models and types. Equivalent Aeronautical Tube Sizes on special order.

MINIMUM PRESSURE DROP AND POWER LOSS . . . Oversize ports and passages give maximum flow at minimum pressure drop, insure greater accuracy and response in hydraulic or large volume air cylinder control.

EASY FLOW ADJUSTMENTS under full pressure. Seal located at port to eliminate air or dirt traps. Gland structure equally effective on pressure or vacuum.

SENSITIVE, CHATTERLESS BALL CHECK . . . Patented design insures rapid ball movement to open or close at low differentials.

FORGED BODIES permit higher pressures with wide safety margins. Aluminum—3000 psi; Steel and Stainless Steel—5,000 psi. Pressure ratings based on better than 5 to 1 safety factor. All internal parts are Stainless. Write for illustrated catalog.

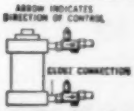
Model F Standard Flow Control Valve or Model N Needle Valve

Model KF Knob and Dial Flow Control Valve or Model KN Needle Valve.

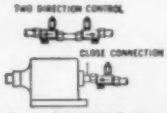
Model PF Knob and Dial Flow Control Valve or Model PN Needle Valve for panel mounting.

Model C Check Valve for In-Line Mounting.

TYPICAL APPLICATIONS



Controlling Double Action Cylinder



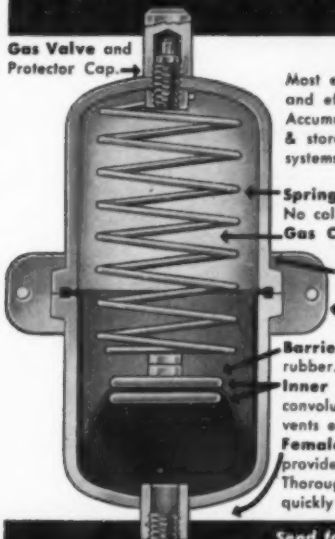
Controlling Single Acting Cylinder

AUTOMATION AUTO-PONENTS INC. COMPONENTS

2919 GRANT STREET
BELLWOOD (Chicago Suburb) ILLINOIS

SPeeCo ACCUMULATORS

EASILY SERVICED...



Most economical and efficient Accumulator for absorbing shock & storage of energy in hydraulic systems. Sizes, 15 to 7500 cu. in.

Spring—Directs bottom of Barrier. No collapsing of Barrier sides.

Gas Chamber—gas precharged to suitable pressure.

Steel Shell—Two sections. Up to 2000 psi pressure.

Clamp Ring—Holds sections firmly. Easily removed.

Barrier—"Hat Shape." Synthetic rubber. "O" ring seals shell sections.

Inner and Outer Plates—Starts convolutions of barrier and prevents extrusion through liquid port.

Female Pipe Threads—Can be provided to meet specifications.

Thorough cleaning maintenance is quickly performed when necessary.

Send for specifications and descriptive literature at once.

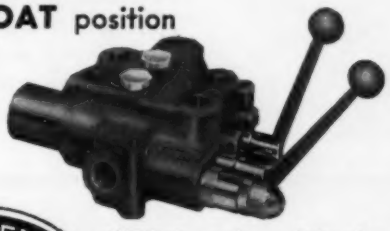
SPECIAL PRODUCTS COMPANY
15000 WEST 44TH AVENUE
GOLDEN, COLORADO

Circle **110** on Time-Saver Card

DIRECTIONAL CONTROL

with **FLOAT** position

MODEL WPK



GRESEN HYDRAULICS

NEW 2-spool parallel valve for snow plows, dozers, loaders, graders and similar mobile equipment.

FIRST SPOOL has four (power-neutral-power-FLOAT) positions. It is spring loaded to neutral, but has a detent in the FLOAT position.

SECOND SPOOL is conventional 3-way or 4-way as required, spring loaded to neutral.

BOTH SPOOLS have separate ball checks—are self centering, fully balanced and accurately feathered for fine metering action.

RELIEF VALVE is cartridge type with hardened seat.

TRIPOD MOUNTING feet make installation easy.

CAPACITY—40 GPM at 20 ft./sec.

MAX PRESSURE—1500 psi.

WRITE FOR LITERATURE

GRESEN *Mfg. Co.*
405 35th Ave., N.E., Minneapolis 18, Minn.

Circle **57** on Time-Saver Card

the first

international compressed air and hydraulics exhibition

and 2nd European Fluid Power Conference

EMPIRE HALL - OLYMPIA - LONDON - 25-29 APRIL 1960

You are invited to visit this great international Exhibition, demonstrating the vast growth and development of pneumatics, hydraulics and control in every branch of commercial and industrial activity.

It will be shown that the immense expansion of industry and the attendant increase of industrial wealth, owes much to the pertinent use of 'fluid power'.

'Fluid power' applications as time and cost saving factors . . . are legion but whether your problem is one of sheer brute strength . . . or one demanding the utmost delicacy and precision, the answer will be found at Olympia.

Specialist companies from the United States, United Kingdom, and Europe are exhibiting and their engineers will be present to discuss your individual problems and requirements.

Complete form below for complimentary tickets and mail today!

Mail This Order Form Today!

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St. Richard's House, Eversholt Street, London, N.W.1. England.

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NOTE OF SPECIAL INTEREST _____

A. H. P. 2.

This Exhibition is sponsored by COMPRESSED AIR & HYDRAULICS, one of the monthly technical journals published by the John Trundell Industrial Group

USEFUL LITERATURE

limits, 1000 F continuous; pressure 0-300 psig. Hydraulics: 35 gpm at 1000 psi, 11 gpm at 2000 psi, 7.5 gpm at 2500 psi. High pressure hydraulics: 0-30,000 psi, oil or water, static; 0-10,000 psi, oil at 1 gpm; temperature range, —65 to 500 F. Impulse testing: surge cycling to 10,000 psi; impact cycling to 4500 psi. Booklet has sections on gage calibration and environments. *Flexonics Research Laboratories, Div. Flexonics Corp., Elgin, Ill.*

Circle **421** on Time-Saver Card

REDESIGNED VARIABLE DISPLACEMENT PUMPS

AS-61680-L-2C and R-2B Series pumps have been improved. In some installations, system pressure surges have caused malfunction of pump shaft seal. Foot valve in inlet flange alleviates this by maintaining correct positive housing pressure. Improved, solenoid-operated valve has moisture-resistant solenoid. Electrical connector relocated from valve body to solenoid to accommodate solenoid. Dimensional changes in valve's internal parts give improved operation. Bulletin A-269 tells how to incorporate changes into these models. Gives new part numbers. *Vickers, Inc., Div., Sperry Rand Corp., Aero Hydraulics Div., Detroit, Mich.*

Circle **422** on Time-Saver Card

STAINLESS STEEL FASTENER SEALS

Sealing devices for bolts, studs, and other fasteners and fittings. For non-corrosive applications. In all standard sizes except —8 and —18. Catalog sheet. *Parker Seal Co., Div. Parker-Hannifin Corp., Culver City, Calif.*

Circle **423** on Time-Saver Card

VALVES

Booklet describes check, relief, shutoff, plug, and custom valves. Contains technical data, construction details, dimensions, materials, operating principles. *Circle Seal Products Co., Inc., Pasadena, Calif.*

Circle **424** on Time-Saver Card

Wagner now offers

AIR POWERED BRAKING SYSTEMS

for industry

Now you can get air powered braking systems with the same dependable heavy duty brakes that Wagner has built for years for hydraulically operated overhead crane brakes. These systems offer unusual flexibility of application, since any number of brakes and control points may be used at any reasonable distance from each other.
Wagner application engineers can supply expert help in applying air power components for your specifications. Call your nearby Wagner branch.

W159-2

Wagner Electric Corporation

6387 PLYMOUTH AVE. • ST. LOUIS 14, MISSOURI

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IN THE MANE WE DO NOT BITE... BUT WE WOULD LIKE A LION'S SHARE OF YOUR BUSINESS *

*

CUSTOM CYLINDERS & VALVES THAT IS- GIVE US A ROAR FOR THE FINEST IN HYDRAULICS! (NO LION)

UNIVERSAL HYDRAULICS

P.O. BOX 4500
CLEVELAND 24, OHIO
PHONE WHITEHALL 2-4595

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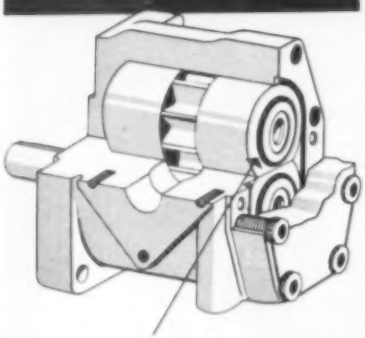
HYDRAULIC
Gear Pumps

Pressure balanced for efficiency



The application of discharge pressure to the bearings as shown creates an optimum counter balancing thrust toward the gear faces which controls leakage and wear.

This feature permits operation with volumetric efficiencies in excess of 90%. Pump sizes from ½ to 60 GPM in 15 models with pressures to 2500 PSI. Also available as gear motors with outputs to 25 HP.

DOWTY
Hydraulic Gear Pumps

Truly a handful of efficient power offered by

Berry
HYDRAULICS
A DIVISION OF THE OLIVER TYRONE CORPORATION

MAIL FOR APPLICATION DATA

Berry Hydraulics
2230 Oliver Building, Pittsburgh 22, Pa.

Name_____

Company_____

Address_____

Circle **25** on Time-Saver Card

POST SCRIPTS OF INDUSTRY

News about people, manufacturers and sales organizations

New York Air Brake promotes Brandt, Jarvis

Howard W. Brandt has been chosen vice president of the New York Air Brake Co. He will continue as general manager of the

Brandt

Jarvis

company's Hydreco Division, Kalamazoo, Mich. Before joining Hydreco in 1957, Brandt had been general manager of the Rochester Div., General Motors. W. Gordon Jarvis is now Hydreco's manager of quality control. He joined Hydreco in 1955 as a sales engineer. In 1958, he was made production control manager; and, in 1959, manager of personnel.

Boston Woven Hose creates two vice-presidencies

Randolph H. Jackson has been selected for the new vice presidency, sales, Boston Hose & Rubber Div., American Biltrite Rubber Co., Cambridge, Mass. Jackson has been director of sales since 1956. Harry A. Borne is now vice president, manufacturing. He was factory manager from 1957.

Hannifin Div. reorganizes on product basis

Parker-Hannifin Corp.'s Hannifin Co. Div. has reorganized its divisional breakdown on a product (as opposed to a functional) basis. Three major product groups have been formed: the Power Cylinder Division, headed by Hannifin v.-pres. H. H. Adams; the Machinery Division, managed by M. E. Lawrence; and the Air Valve and Crown Division, under Z. J. Lansky.

Peters is OPW-Jordan regional sales manager

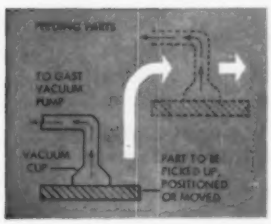
Peters

Robert J. Peters is now regional sales manager of the Southeast and Midcontinent area for OPW-Jordan, Cincinnati, Ohio. Peters, who has been with the company since January as a sales engineer, is also responsible for advertising and sales promotion.

Continued on page 132

A NEW PLANT in Mentor, Ohio, marks the third expansion in five years for Fluid Controls, Inc., Mentor. The plant houses special manufacturing and test equipment.

Circle **54** on Time-Saver Card



NEW

Gast Booklet ready to give you

"APPLICATION IDEAS"

on uses of air motors, compressors, vacuum pumps

Looking for new ways to improve methods—save time—or cut costs? This booklet may be valuable to you! With line drawings, it shows dozens of the basic principles of "putting air to work".

With photographs of our customers' products—from air mixers to data plotters—it illustrates each principle. . .and shows how Gast rotary Air Motors, Compressors and Vacuum Pumps provide advantages as original equipment or in plant use.

Design Engineer or Plant Master Mechanic, you'll find this booklet of interest. . .and it may "spark" an important idea you can use!

WRITE TODAY FOR NEW "APPLICATION IDEAS" BOOKLET!

Gast Manufacturing Corp.
P.O. Box 117-D
Benton Harbor, Mich.

GAST ROTARY

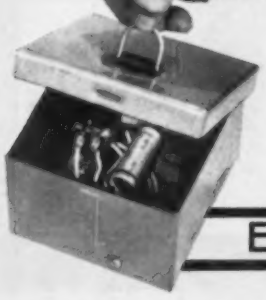
- AIR MOTORS TO 7 H.P.
- COMPRESSORS TO 30 P.S.I.
- VACUUM PUMPS TO 30 IN.

"Air may be your answer!"

NEW!

PULSE CONTROLLER

PC-600 series



EXTENDS or Shortens electrical impulse

Here's a single unit that does both! Extends or shortens the duration of an electrical impulse.

Ideal for hydraulic and pneumatic machinery, and other applications where efficiency can be improved by adjusting the length of the actuating pulse.

Standard models available in a wide range of adjustability and enclosure types.

Write today for PC-600 literature, including specifications and full information.

WARCO Industries INC.

6625 DELMAR BLVD. • ST. LOUIS 30, MO.

Circle **120** on Time-Saver Card

PRECISION-BUILT

HYDRAULIC VALVES AND PUMPS..

to YOUR specifications

Over twenty years of specialized hydraulic valve and pump experience — newly enlarged, modernly equipped manufacturing facilities — an outstanding staff of thoroughly experienced craftsmen and an imposing list of satisfied customers is the best recommendation we can think of that you too will like our work.

Hydraulic valve and pump building is a highly specialized field demanding skills and equipment which many important companies have found too costly to maintain in their own plants. We are doing their work today.

Why not invest a few minutes to hear the advantages of our service. It might well save you money and headaches.

HYDRAULIC ACCESSORIES CO.

24301 Hoover Road, Warren (Detroit) Mich.

Circle **64** on Time-Saver Card

The INSIDE INFORMATION

Here's literature prepared expressly for design men to simplify selection and application of the most appropriate molded packings for better product designs. These bulletins are packed with helpful charts, dimensions, diagrams, application drawings, recommendations and hints to save material and machining costs. They're yours for the asking—can help considerably in your quest for stepped-up product efficiency.

To help you keep abreast of up-to-the moment developments, trends, changes . . . write for your complimentary Palmetto Kit for Design Engineers.

ABOUT PALMETTO® MOLDED PACKINGS

The entire line is engineered for efficient utilization of space, material and cost. If you design-in molded packings for fluid powered equipment—you should specify and buy the proven performance Palmetto line.

PALMETTO G-T® RING — Effectively seals, without extrusion, at temperatures from —70 F to +600 F, and at pressures as high as 10,000 psi. Unique T-shape prevents wedging into clearances, pinch-offs under motion or pressure, or twisting in place. Absolutely resistant to destructive deformation.

PALMETTO PYRAMID® — An advanced form of V-rings, offered in two distinctive designs for broad hydraulic and pneumatic service. Sets of shallow Pyramid serve where packing space is limited; deep Pyramid sets are used where unusual sturdiness is necessary.

PALMETTO U-RING—Rugged, deep design increases stability, eliminates rolling in the groove. Excellent in low or high pressure cylinders—nominal or oversize bores.

PALMETTO KUP—An exceptional piston packing available in a variety of fabrications to seal the standard, or new synthetic fluids. More resistant to heat than leather . . . will not dry out and leak.

Whatever your sealing requirements—including diaphragms, Viton® molded parts, and other molded shapes — Palmetto engineers will work with you. Write today for your Palmetto Kit for Design Engineers — Feel free to call on Palmetto Design Service for assistance.

GREENE, TWEED & CO.
NORTH WALES, PA.

Circle **129** on Time-Saver Card

POST SCRIPTS OF INDUSTRY

Borkowski to manage production, engineering

Robert J. Borkowski has been appointed manager of production and engineering at Schroeder Brothers Corp., McKees Rocks, Pa. Since 1953, he has specialized in new product tooling equipment as a plant project engineer for McKinney Mfg. Co., Pittsburgh, Pa.

Parker Seal adds three to sales force

Parker Seal Co., Culver City, Calif., has appointed Jess Foltz as a sales engineer. He was with the company's customer relations staff. Berne McGee will take over Parker accounts in Southern California. Working out of Houston, Robert C. Rickey will handle Parker sales in Arkansas, Texas, Mississippi, Louisiana, and Tennessee.

Ensign to manage Marsh Instrument sales service

W. M. Ensign has been appointed sales service manager for all products of Marsh Instrument Co., Div. Colorado Oil & Gas Corp., Skokie, Ill. For eleven years, Ensign was assistant sales manager of the Marsh Heating Division.

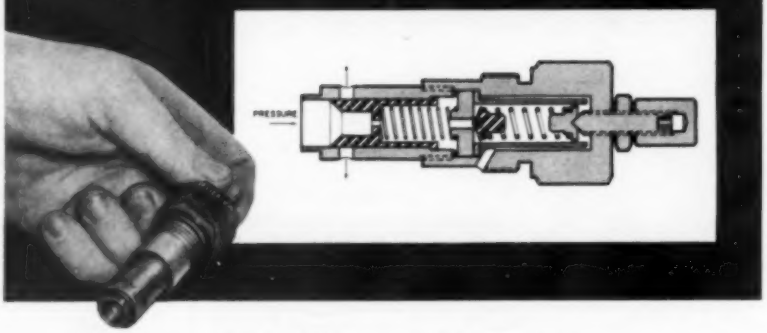
Ensign

Pfeifer

Pfeifer joins Vickers' Marine & Ordnance Dept.

Mel Pfeifer is now staff engineer of the Marine & Ordnance Dept. of Vickers, Inc., Waterbury,

CARTRIDGE RELIEF VALVE
for your manifold or pump body



- **Eliminates Cost of Piping**
- **Saves Space**
- **Simplifies Maintenance & Service**
- Simple Machining
- Pressure Ranges up to 4000 Psi
- Flow Capacity up to 60 Gpm

Write for detailed literature

Fluid Controls, inc.
Member of National Fluid Power Association

Manufacturers of Hydraulic Valves and Devices
Relief Valves • Check Valves • Restrictor Valves
Needle Valves • Pilot Check Valves • Special Valves
Pressure Compensated Flow Regulators

1284 N. CENTER STREET • MENTOR, OHIO

Circle **47** on Time-Saver Card

Conn. Pfeifer was in charge of developing electrohydraulic servo components and systems as engineering section head at Sanders Associates.

Ted Palmer joins Holden sales engineering staff

Holden Engineering Co., Cleveland, Ohio, has added Ted Palmer to its staff of sales engineers specializing in fluid power. In recent years, Palmer has been in northern Ohio industrial sales.

B&W names two in district sales

J. J. Koss has been appointed Milwaukee district sales representative for the Babcock & Wilcox Co.'s Tubular Products division. In 1946, Koss joined Globe Steel Tubes Co., in the Chicago sales district. When B&W purchased Globe in 1955, he remained as sales representative. Succeeding Koss is T. J. Nagle, who joined the division's New York sales office in 1947, becoming representative in 1957.

Oilgear opens Houston office

Healy

The Oilgear Co. has opened a district sales, service, and application engineering office in Houston, Tex. The district—including Texas, Oklahoma, Arkansas, Louisiana, Mississippi, Tennessee, and western Alabama—was formerly covered by the Rockford and Milwaukee offices. Thomas M. Healy will be in charge. He was an Oilgear sales and service engineer from 1953.

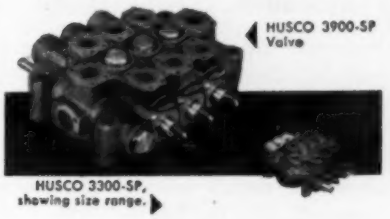
Hercules Packing moves from Buffalo to Alden, N. Y.

Hercules Packing Corp. has moved from Buffalo to new, larger quarters in Alden, N. Y. The move permits Hercules to add new equipment for its die cutting, braiding, and phenolic departments.

Continued on next page

Circle **66** on Time-Saver Card

Why **HUSCO HYDRAULIC MULTI-PLUNGER VALVES** *fit a greater range of control needs . . .*



HUSCO 3300-SP, showing size range.

- Choice of FIVE Basic Model Sizes — over 120 standard valves for unlimited modifications to specific needs.
- Control up to SIX Cylinders, single or double acting.
- Up to FOUR Standard Control Positions — raise, lower, float and neutral.
- Available with Flange or Standard Mounting (3900 Valves only).
- Accurately Rated Capacities from 3 to 185 G.P.M. at 22 f.p.s. velocity.

These are only a few reasons why HUSCO Valves are more flexible in adaptation to your needs, more efficient in power-saving control.

Write for detailed specifications on HUSCO 3300-SP and complete catalog "Husco's House of Ideas" — or engineering aid on your hydraulic control needs.

HYDRAULIC UNIT SPECIALTIES CO.
PUMPS • VALVES • CYLINDERS
P. O. Box 257-A, Waukesha, Wisconsin
West Coast Representatives
EASTMAN PACIFIC CO., Los Angeles, Calif.
ROY BOBBS AIR-DRAULIC CO., Portland, Ore.

STAFFA

HIGH TORQUE VARIABLE SPEED (1-100 r.p.m.) HYDRAULIC MOTORS

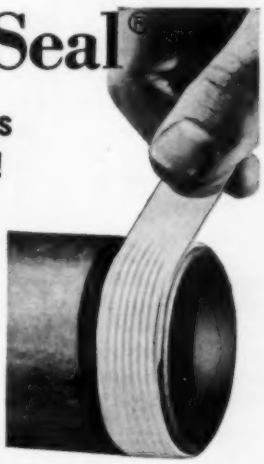
Three Models now in production:
Mark III—5 cylinder 3,500 lbs. ft. at 1,500 p.s.i. (Speed 1-100 R.P.M.) **Mark IV**—5 cylinder 4,500 lbs. ft. at 2,000 p.s.i. (Speed 1-100 R.P.M.) **Mark V**—7 cylinder 6,600 lbs. ft. at 2,000 p.s.i. (Speed 1-75 R.P.M.) Overall efficiency 90% to 95%.
Ideal drive for conveyors, rolling mills, cranes, tractors, drills and most mechanical handling applications.
Ask for details of hydraulic cylinders, valves, pumps and motors.

CHAMBERLAIN INDUSTRIES LTD
Staffa Works, Staffa Rd., Leyton, London, E.10, England.
Leytonstone 3678
(Member of the Chamberlain Group of Companies)

Circle **29** on Time-Saver Card

new Tape-Seal®

seals hydraulic fittings 7 ways better, faster!



Not just another sealing compound! Tape-Seal, made from Du Pont's miracle Teflon®, *wraps* around connection . . . gives you these 7 important advantages:

Faster, easier to apply . . . wrap around connection, tear off, that's all ■ Never hardens . . . disassemble with ease, anytime ■ Completely insoluble and inert to chemicals, alkalies, and acids ■ Seals both threaded and flared joints. Ideal for packing ■ Unaffected by temperatures −250° to +500° F ■ Lubricates as it seals . . . completely eliminates thread-galling even on stainless steel ■ Withstands high pressures and vibration ■ In widths of ½", ¾", 1", 4" and wider.

▶ **Send for free sample!**

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Friesland, Wisconsin

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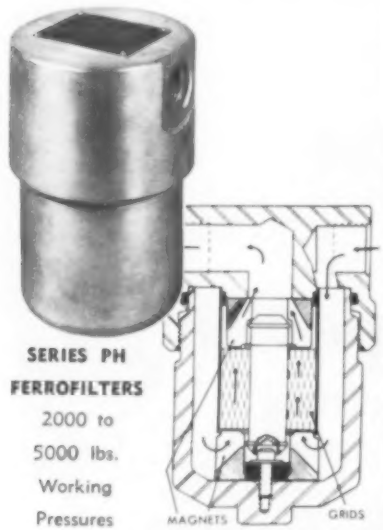
Remove ferrous grit for maximum hydraulic performance

Wear can give you abrasive ferrous particles. Completing the vicious circle, these particles can give you more wear—and besides, cause sticking of valves, pistons and other moving parts. For certain removal of these particles, give the job to

FERROFILTER®

High Pressure MAGNETIC SEPARATORS



SERIES PH FERROFILTERS
2000 to 5000 lbs. Working Pressures

Hydraulic fluid flows through a stack of magnetized grids which split the stream into many thin elements. Magnetic particles pass close to the grid edges, are attracted and held securely until the FERROFILTER is cleaned.

Flow capacity 12 to 40 gpm . . . Low pressure drop . . . Standard ¾" tube or pipe connections; other sizes available.

Write for New Brochure

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652 Kline Ave. at Brunswick Pike
P.O. Box 1138 Trenton 6, N. J.

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POST SCRIPTS OF INDUSTRY

Henley moves to Meletron

Harry L. Henley has joined Meletron Corp., Los Angeles, Calif., as evaluation engineer in charge of the engineering laboratory. He will take care of liaison with Meletron's sales engineers. Henley had been instrumentation engineer, research, at Rocketdyne's propulsion laboratory, Santa Susanna, Calif.

New distributors

Marvin A. Heeren & Co., Moline, Illinois, will handle the Crown compressed air line units made by Hannifin Co. Division, Parker-Hannifin Corp., Des Plaines, Ill. *C & E Roth Tool & Supply Co., Albuquerque, New Mexico,* will handle the Crown line and products of Parker-Hannifin's Fittings & Hose Div., Cleveland and Eaton, Ohio. *Sturgis Valve & Fitting Corp., St. Louis, Mo.,* and *Dagwell-Dixie Co., Oklahoma City, Okla.,* will distribute products of the Fittings & Hose Div.

The Hydraulic Power Division of the Hydraulic Press Mfg. Co., Mount Gilead, Ohio, appointed:

The Paquin Co., Cleveland, Ohio, for parts of Ohio, Indiana, and Kentucky; *The Tod Engineering Co., Brookfield, Mass.,* for New England; *J. Samuel Butler, New Orleans, La.,* for Louisiana; and *Air-Hydraulics Co., Inc., St. Louis, Mo.,* for eastern Missouri and southern Illinois.

The Eads Co., Houston, Texas, will distribute for Commercial Filters Corp., Melrose, Mass.

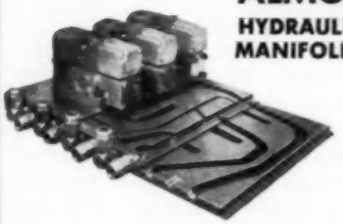
Harkins Engineering Sales Co., Indianapolis, Ind., will represent Ajax Flexible Coupling Co., Inc., Westfield, N. Y.

Haylett O'Neill & Son, Houston, Tex., will cover southern Texas and western Louisiana for Sterling, Inc., Milwaukee, Wis., manufacturer of temperature control units.

LET'S TALK MANIFOLD FACTS!

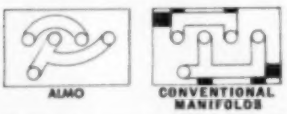
The advantages of (Almo) manifolds as opposed to other manifolds are many. Their unique design offers complete flexibility in the mounting of take-offs and valves. Thus an Almo manifold is more adaptable to your requirements. Here are 3 features that definitely effect performance, weight and size.

ALMO* HYDRAULIC MANIFOLDS



1. Flow lines are short as possible with no corners or sharp recesses to collect dirt and obstruct flow.

2. Method of construction permits better utilization of area, smaller overall dimensions and fewer complications while maintaining correct channel dimensions and constant operating pressures. PSI capacity is a built-in quality.



3. Rectangular cross section of flow lines makes possible thinner overall construction and less weight than in comparable manifolds.

WEIGH THESE FACTS!

Let us work with you in improving your product. Write for brochure.

ENGINEERING RECOMMENDATIONS

*"THE UNIQUE FLUID CIRCUIT"

ALMO
MANIFOLD & TOOL CO.
11472 KALTZ / CENTERLINE, MICH.

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MARKET PLACE

When replying to a box number in the Market Place, address your letter to Applied Hydraulics & Pneumatics, 812 Huron Road, Cleveland 15, Ohio. Attention: Box No.

FLORIDA OPPORTUNITY

If you have a background of productive experience as a sales engineer—preferably with pneumatic experience—you may be the man I am looking for to associate with me in a fast growing Southeast selling organization with headquarters in Central Florida. Basic lines which I represent both on direct factory & warehouse basis make this association attractive. A modest investment will be necessary. Write to Box 2160, APPLIED HYDRAULICS & PNEUMATICS.

ENGINEER-EDITOR

Do you have a basic engineering knowledge? Can you think and write clearly about technical subjects? Would you enjoy a position with variety, challenge, potential?

If your answer is *yes*, we'd like to discuss an opening on our editorial staff. Send your resume to:

APPLIED HYDRAULICS & PNEUMATICS
812 Huron Rd. Cleveland 15, Ohio

REPRESENTATION WANTED

Exclusive sales representation in the following areas: San Francisco, Portland, Seattle. Top lines of rotating and non-rotating pneumatic and hydraulic cylinders, and high production power chucking equipment. Reply with exact territorial boundaries, number of salesmen in field, products now being sold and principal's names. Send reply to Box 2260, APPLIED HYDRAULICS & PNEUMATICS.

SALES ENGINEER WANTED
of Sales Manager Caliber

Progressive management's new sales program for Wilkerson Corp. —leading manufacturer of filters, regulators and lubricators,—needs man with following qualifications

- Experienced in pneumatics
- Able to conduct sales meetings, train distributors and carry on field sales work.
- Must be willing to live in Denver and travel nationally at least 65% of time.
- Have personal drive and enthusiasm.

Right man will receive income in 5 figures, salary, expenses and incentives. Wilkerson products are marketed through distributors.
If you have these qualifications write to: Mr. Don Benner
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Wilkerson Corp.
1643 W. Girard
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PRODUCTION ENGINEER: familiar with precision hardware to establish assembly and testing techniques; diagnose production problems; provide technical liason between engineering and manufacturing.

PROTOTYPE ENGINEER: adapt basic designs; trouble shoot and evaluate components to establish producibility and reliability; perform technical liaison with customers.

These and other engineering positions offer you unusual professional advancement in the dynamic field of electrohydraulic servocontrols. The advantages of small company atmosphere in a suburban environment, the merits of profit sharing, and the prestige of industry leadership are yours with . . .

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THE RIGHT GAUGE FOR YOUR SPECIFIC NEEDS

Available in a wide variety of general purpose and special purpose gauges in pressure ranges to meet your specifications in every particular.

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- VACUUM
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- ALTITUDE
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MARSHALLTOWN MFG. COMPANY
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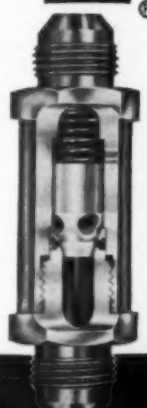
Kep-O-seal



Flexible Seal Seat* VALVES

- CHECK VALVES
- RELIEF VALVES
- SHUTTLE VALVES
- CARTRIDGE VALVE INSERTS

Specify Kep-O-seal! — leakproof construction designed for efficient fluid flow and reasonable cost. This name is your assurance of quality; backed by two generations of specialized service to industry.

*PAT. APP'D. FOR.

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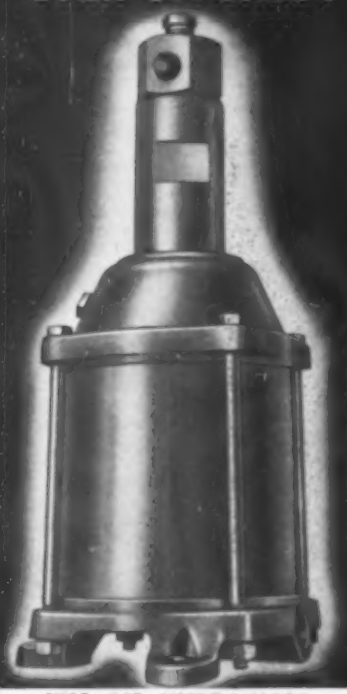
NEW from WILTON!

THE BIGGEST BOOSTER BARGAIN EVER OFFERED!



IT'S AIR HYDRAULIC!

Delivers over 3 cu. in. at 3000 psi for less than $100!

It's true! Mass production for our own air-hydraulic products enables us to offer the Wilton high output-pressure booster at half the usual cost! Simple, rugged construction, designed to operate more than a million cycles without maintenance. Easily replaceable seals; wiper cup protecting main seal; anti-friction hydraulic piston; pressed bronze filter in breather hole. Air cylinder and piston are non-ferrous and corrosion proof. Dependable performance proven by thousands of installations. Lower pressures also available. Get the facts about this booster bargain today!*

ATTACH THIS AD TO YOUR LETTERHEAD AND MAIL FOR FREE LITERATURE!

* O.E.M. inquiries invited, and will be quoted discount prices. Quotations for unusual requirements submitted on request.

WILTON

TOOL MANUFACTURING CO. INC.

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Sold by leading distributors the world over!

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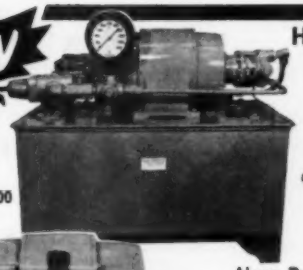

DPU-5-3000

DPU-15-5-1500

HYDRAULIC "AUTOMATION" "HI-LO" PRESSURE PUMPING UNITS

Above Pumping Units give total volume of both pumps until cut-out pressure of the large volume-low pressure pump reaches the maximum setting of the unloading valve. The low volume-high pressure pump takes-over until maximum setting of unloader or relief valve on high pres. circuit is reached.

(1) No. DPR-21-1500 – A 21 GPM PUMPING UNIT and RESERVOIR

An ideal unit for any application where a fast approach to work load is needed. Delivers 21 GPM at 1500 PSI with a 5 HP, 220/440 V., 3-phase, 60 cycle AC motor. Has 17 GPM large volume, low pressure pump which can be set to unload from 50 to 450 PSI. Also a 4 GPM low volume, high pressure pump which can be adusted to 2000 PSI. As shown mounted on 31 gallon reservoir (available w/o reservoir) 625.00

(2) 5 GPM – 3000 PSI PUMP UNIT

Has a 3 HP, 220/440 V., 3-phase, 60 cycle AC motor. The large volume, low-pressure pump is a variable displacement type. Has 3-1/2 GPM volume and automatically unloads at 600 PSI. The low volume, high pressure pump delivers 1-1/2 GPM at 3000 PSI. Fixed displacement type. Pressure must be controlled by external relief or unloading valve.
No. DPU-5-3000 as shown . . 310.00

Same as above but mounted on a 18 gallon reservoir 535.00

(3) 15-1/2 GPM – 1500 PSI PUMP UNIT

Has 3 HP, 220/440 V., 3-phase, 60 cycle AC motor. Large volume, low-pressure pump delivers 14 GPM up to 300 PSI. A fixed displacement type. External unloading valve must be used. The low volume, high pressure pump delivers 1-1/2 GPM at 1500 PSI. Fixed displacement. Unloading or relief valve must be used to control the pressure.
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Same as above but mounted on an 18 gallon reservoir 525.00

SPECIAL 25 GPM PESCO PUMP

A special Polley Government Surplus Value. Positive Displacement type. Delivers 25 GPM at 3450 RPM. Pressure limit is 500 PSI continuous or 1000 PSI intermittent. Cat. No. H-P25SU Without pump mount. ONLY 27.95

PUMP MOUNT – As shown on pump above. Has sealed-in bearings and 4-hole foot mount . . . . . Only 16.95

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Designed for U.S. Navy to remotely elevate large guns. Has 3500 RPM, 5 HP (intermittent), 3 HP (continuous), 220–440 Volt, 60 cycle, 3-phase motor. The motor hooked to a Vickers heavy duty, variable volume reversible pump – No. P-V 2003-S108. Pump delivers approx. 7 GPM. Also included is elect. controls

Originally cost approx. $2000 $195

WOOSTER – 4500 RPM DYNAMOMETER TEST STAND

To check Torque on pumps, fluid motors, generators, etc. Complete with 10 HP, 1725 RPM, 220/440 V AC, 3-phase, 60 cycle motor. Motor drives a 5 KW, DC Generator to supply current for a 5 HP, DC Variable speed motor. Stand has a torque scale and tachometer. Comes with complete power panel; a Rockwell 20 GPM rotary flow meter; an 85 GPM, 3,000 BTU Ross heat exchanger and a large volume Cuno Air Filter. NOW.. $1475

New Hydraulic Cylinders

Designed to meet the most rigid requirements of industry. All are heavy duty steel. Shown here are 2 of our line.

Available in heavy duty press type cylinders of 3", 5", 6" and 8" bores – thrust up to 75 tons. Also in internal cap types as at right above – with up to 4" bore and up to 18,850 lbs. of thrust at 1500 PSI. Write for complete list of Special Palco Hydraulic Cylinders.

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A GREER Test Stand. Capacity of 20 GPM at 5000 PSI with a 60 HP, 220/440 V., 3-phase AC motor. Complete with a Denison 700 series, variable displacement pump. Console stand is 7 ft. high x 12 ft. long. . . . . NOW ONLY $4500.00

HYDRAULIC TEST STAND – With 30 HP, 220/440 V., 3-phase AC motor. Delivers 20 GPM at 3000 PSI. Has a Vickers variable displacement pump. A Surplus Bargain $2500.00

palley's

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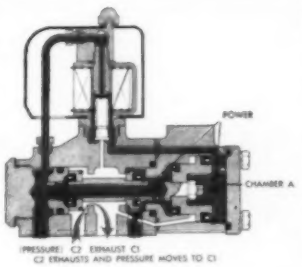

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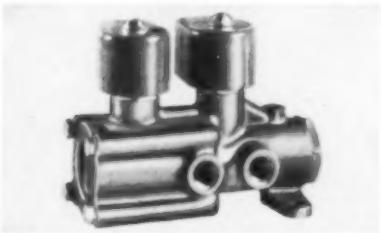

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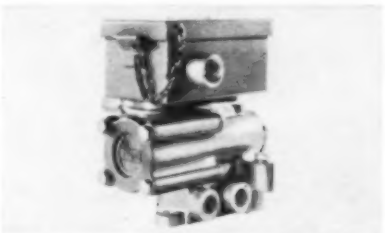

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